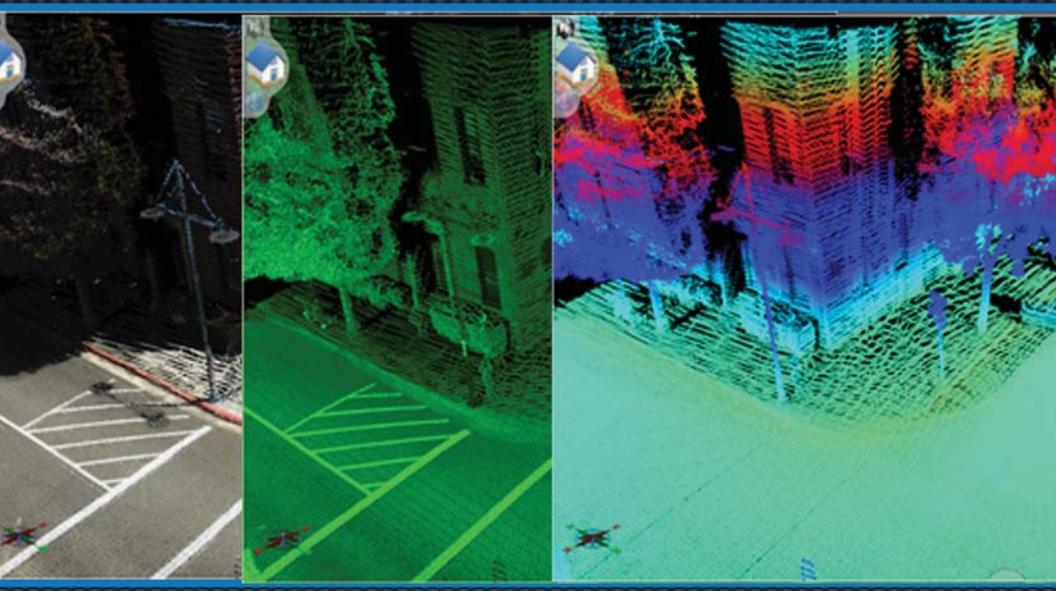
Spatial Factory



User's Manual

TOPCON

TOPCON
POSITIONING SYSTEMS

Spatial Factory User's Manual

Part Number 7010-1000
Rev A

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September, 2010

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This manual uses the following conventions:

Example	Description
File ▸ Exit	Click the **File** menu and click **Exit**.
Connection	Bold typeface indicates the name of a dialog box, screen or window, field, or tab.
Operator's Manual	Italic typeface indicates another publication.
Ctrl+Shift	Press the **Ctrl** and **Shift** keys at the same time.
Double-Click	Click the left mouse button twice.
Enter	Press or click the button or key labeled **Enter**.

Further information to note about the configuration, maintenance, or setup of a system.

Supplementary information that can help you configure, maintain, or set up a system.

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Under no circumstances should this action be performed.

Notes:

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Introduction

The Spatial Factory program enables the user to load and view processed IP-S2 Lidar and image data, and create various attributes from collected objects within a given dataset.

System Requirements

Your computer must meet the minimum requirements listed in Table 1-1 to run the post-processing software, Spatial Factory.

Table 1-1. System Requirements

Component	Minimum Requirements
Processor	Dual-Core 2.5 GHz or higher
RAM	4 GB
Hard Disk	75GB
Graphics	NVIDIA GeForce 9800 GT with 512 MB dedicated VRAM (ATI and graphics cards with shared VRAM are not supported).
Operating System	• Microsoft Windows XP Professional 32-bit SP3 and 64-bit SP2 • Microsoft Windows 7, 64-bit

Installing Spatial Factory

1. Double-click the Spatial Factory executable file from the computer's hard drive, and click **Run**.
   The **Installer Language** window appears (Figure 1-1).

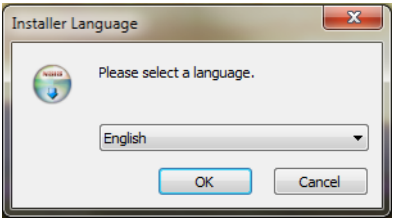


Figure 1-1. Installer Language Window

2. Select your language preference, and click **OK**.
   The **Spatial Factory Setup Wizard** appears (Figure 1-2).

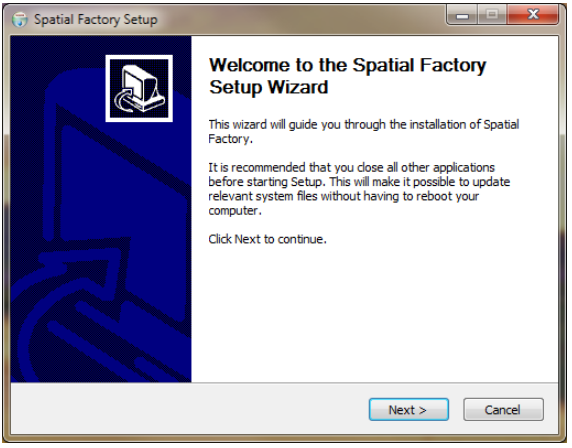

Spatial Factory Setup
Welcome to the Spatial Factory Setup Wizard
This wizard will guide you through the installation of Spatial Factory.
It is recommended that you close all other applications before starting Setup. This will make it possible to update relevant system files without having to reboot your computer.
Click Next to continue.
Next >
Cancel

Figure 1-2. Spatial Factory Setup Wizard

3. Click **Next**.
   The **Choose Install Location** window appears (Figure 1-3).

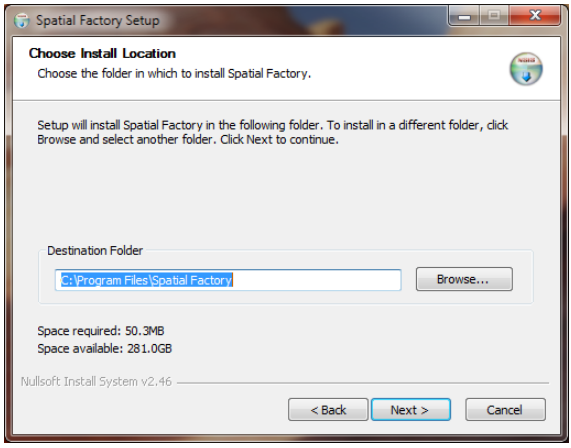

Spatial Factory Setup
Choose Install Location
Choose the folder in which to install Spatial Factory.
Setup will install Spatial Factory in the following folder. To install in a different folder, click Browse and select another folder. Click Next to continue.
Destination Folder
C:\Program Files\Spatial Factory
Browse...
Space required: 50.3MB
Space available: 281.0GB
Nullsoft Install System v2.46
< Back
Next >
Cancel

Figure 1-3. Choose Install Location Window

4. If the destination folder in which to install the Spatial Factory program is correct, click **Next**. If not, click **Browse**, locate a different folder in which to save the program, and then click **Next**.
   The **Choose Start Menu Folder** window appears (Figure 1-4).

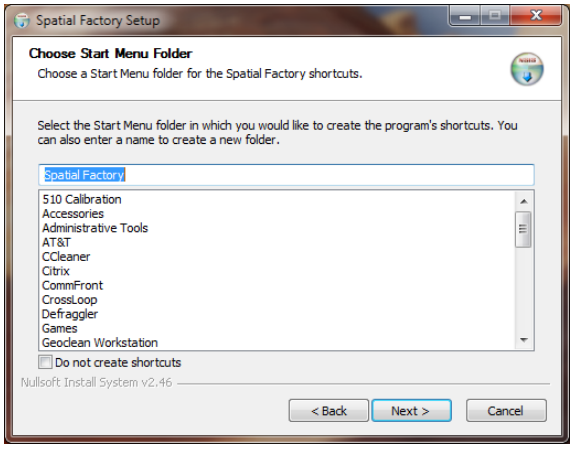


Figure 1-4. Choose Start Menu Folder Window

5. Select a Start menu folder in which to create a Spatial Factory shortcut, and click **Next**.
   The **Choose Components** window appears (Figure 1-5).

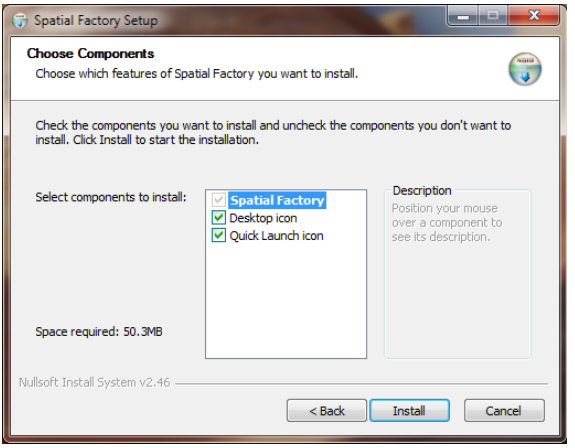

Spatial Factory Setup
Choose Components
Choose which features of Spatial Factory you want to install.
Check the components you want to install and uncheck the components you don't want to install. Click Install to start the installation.
Select components to install:
Spatial Factory
Desktop icon
Quick Launch icon
Description
Position your mouse over a component to see its description.
Space required: 50.3MB
Nullsoft Install System v2.46
< Back
Install
Cancel

Figure 1-5. Choose Components Window

6. Click **Install** to keep the components that are selected by default (recommended).
   The **Installing** window appears, displaying a progress bar (Figure 1-6).

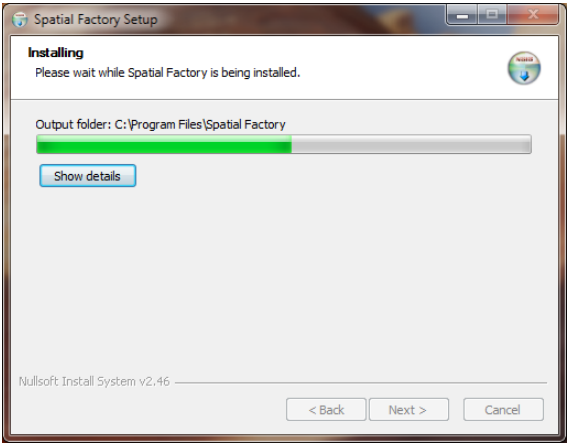


Figure 1-6. Installing Window

Once the installation is complete, the **Completing the Spatial Factory Setup Wizard** window appears (Figure 1-7).

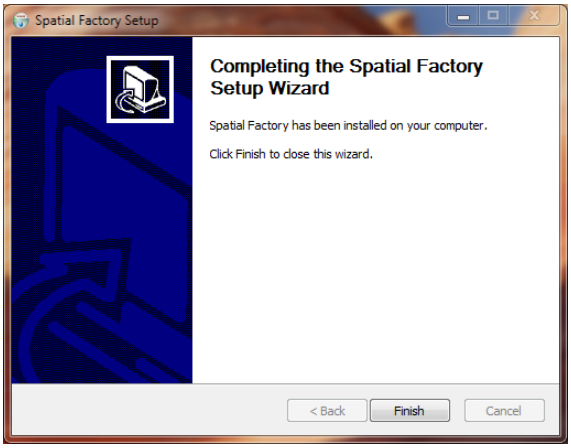


Figure 1-7. Completing the Spatial Factory Setup Wizard Window

7. Click **Finish**.

Installing a new Spatial Factory License

Upon first opening Spatial Factory, the user is prompted to install a license file. This section provides instructions for installing this license. The user is not asked to install the license file again.

1. Open Spatial Factory on the computer.

   When opening Spatial Factory for the first time, the program prompts the user to install a valid license file (Figure 1-8).

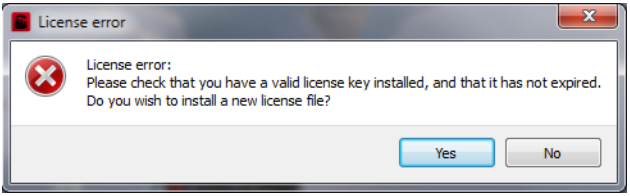

License error
License error:
Please check that you have a valid license key installed, and that it has not expired.
Do you wish to install a new license file?
Yes
No

Figure 1-8. License Message

2. Click **Yes**.
3. Click **Browse** to locate a directory, and then click **OK** to install the license file.

   The **Choose a workspace directory** window (Figure 1-9) appears. The workspace directory is used to save collected attributes from within a given IP-S2 dataset.

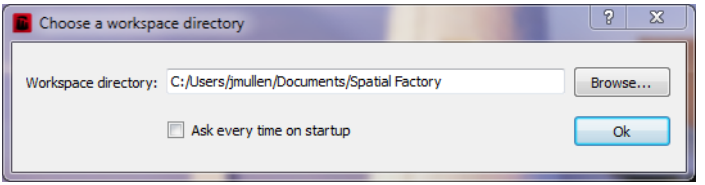


Figure 1-9. Choose a Workspace Directory window

4. Click **Browse** to select a new location for the workspace directory, and then click **OK**.

If you want to select a new workspace directory every time you open Spatial Factory, select the **Ask every time on start up** check box. If you do not select this check box, you can still change the workspace directory on the Preferences window (**File ▸ Preferences**).

The **Workspace directory not found** window appears if the directory has not been created or it has been deleted by the user.

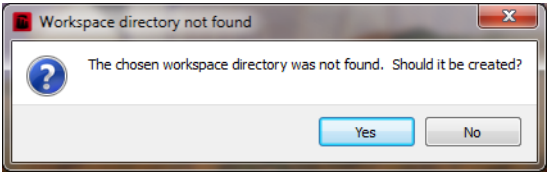


Figure 1-10. Workspace Directory Not Found

5. Click **Yes**.

Getting Started

This chapter helps you become familiar with the Spatial Factory features and layout. It describes how to define preferences, set up workspaces, and everything else you need to know to get started.

Getting Familiar with Spatial Factory

Spatial Factory provides an efficient work user interface designed to make data loading, viewing, and attribute creation quick and easy. Becoming familiar with the user interface layout helps the user perform the instructions in this guide faster and with more accuracy (Figure 2-1).

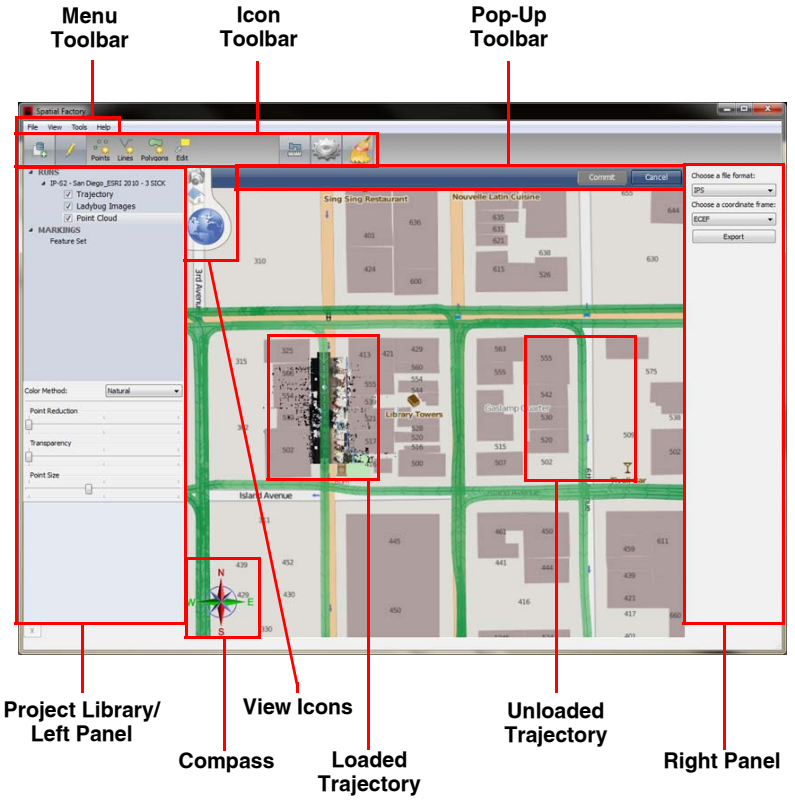


Figure 2-1. Interface Identification

- **Menu Toolbar**: Allows the user to change user preferences, modify work spaces, install a new license file (when necessary), and provides access to the same functions on the Icon toolbar.
- **Icon Toolbar**: Provides quick access to the various tools and functionality of Spatial Factory.
- **Pop-up Toolbar**: A context sensitive toolbar that appears at the top of the main window and displays the required user input for the current task being performed.
- **Project Library/Left Panel**: Displays the loaded IP-S2 datasets, and any loaded or created attribute information.

- **Compass**: Shows the direction in which you are viewing the trajectory.
- **View Icons**: Enables the user to switch between the Map, 3-D, and Panoramic views.
- **Loaded Trajectory**: A section of the vehicle trajectory displaying currently loaded IP-S2 data.
- **Unloaded Trajectory**: A section of the vehicle trajectory during a data run that is not currently loaded.
- **Right Panel**: Appears when the user is performing import/export functions and when the camera calibration or control point registration features are in use.

Navigating the WorkSpace

The Spatial Factory interface is primarily designed for navigation by a mouse. Table 2-1 provides a list of navigation shortcuts. See also “Keyboard Shortcuts” on page 2-5.

Table 2-1. Navigation Views

Icon	View	Action	Result
	Panoramic View	Navigation and Viewing Inside Photos	
		Left Drag	Looks around inside of the image.
		Right Drag	Traverses through images.
		Left Double-Click	Advances to the image closest to the clicked point.
		Scroll Wheel	Advances to the image with the best view of the clicked point

Table 2-1. Navigation Views

Icon	View	Action	Result
		Up Arrow	Traverses forward through images.
		Down Arrow	Traverses backward through images.
	3-D View	Navigation in 3-D Around Trajectories, Point Clouds, and Features	
		Left Drag	Pans the view.
		Left Double-Click	Centers the selected item on the screen.
		Right Drag	Rotates the view.
		Click the Scroll Wheel	Re-centers and reorients the current view on the clicked point.
		Roll the Scroll Wheel	Zooms in or out.
	Map View	Navigation in 2-D Relative to Map	
		Left Drag	Pans the map.
		Scroll Wheel	Zooms in or out.
		Left Double Click	Centers the selected item on the screen.

Keyboard Shortcuts

Keyboard shortcuts enable the user to quickly perform common operations, navigate the user interface, and switch views. Table 2-2 provides a list of Spatial Factory shortcuts.

Table 2-2. Keyboard Shortcuts

Icon	Location	Shortcut	Result
	Menu	Program Shortcuts	
		Control O	Open an IP-S2 dataset
		Control I	Import files
		Control E	Export files
	Navigation	General Navigation Shortcuts	
		1, 2, or 3	Switches between panoramic, 3D, or Map
		+, 5	Zoom in
		-, 4	Zoom out
	Panoramic View	Navigation and Viewing Inside Photos	
		Up Arrow	Traverses forward through images
		Down Arrow	Traverses backward through images
	3-D View	Navigation in 3-D Around Trajectories, Point Clouds, and Features	
		o	Orthogonal view
		p	Perspective view
		t	Switches trajectory on/off

Viewing Modes

The project area contains the graphics and consists of three primary views represented by icons: Map View, 3-D View, and Pano View. The user can select an icon to change the way he or she looks at the dataset.

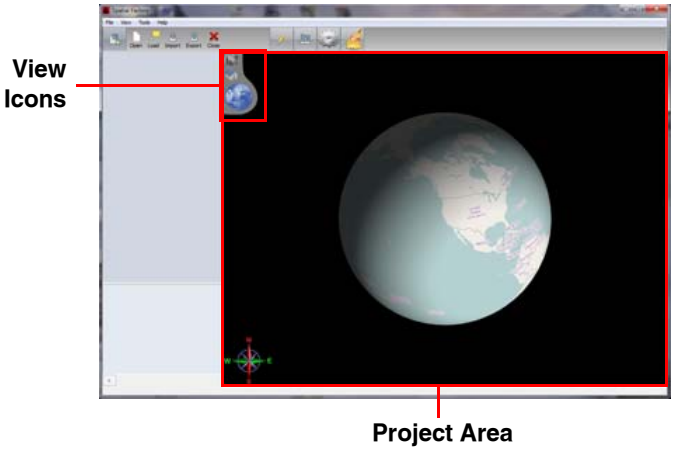


Figure 2-2. Project Area and View Icons

The Map View

The Map View displays in 2-D the current trajectory for the IP-S2 dataset that is loaded, and the current section of point cloud and images that are loaded (where the camera images are displayed as blue spheres). The point cloud and images are overlayed on a background map in the project area.

The user can access the Map View by clicking the **Globe** icon in the project area or by clicking **View ▸ Map Mode**.

The user can only view the background map in the Map View if the computer has an active Internet connection.

Within the Map View (Figure 2-3), the user can:

- Pan the project area

- Zoom in and out around the background map
- Zoom in and out of the loaded IP-S2 project area

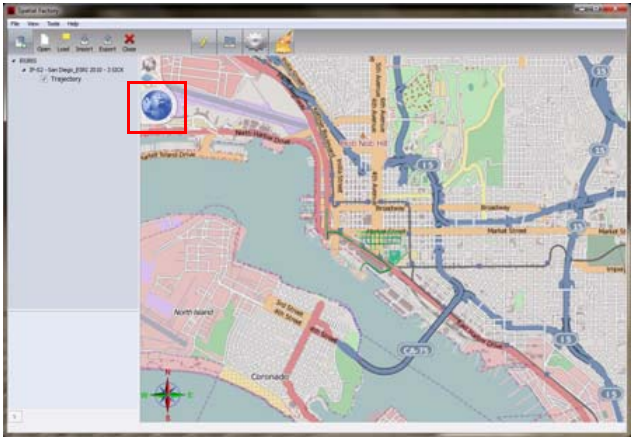


Figure 2-3. Map View – Globe Icon

The 3-D View

The 3-D View displays the currently loaded vehicle trajectory as well as the loaded section(s) of point cloud and image data (where the camera images are displayed as blue spheres).

The user can access the 3-D View by clicking the **House** icon in the project area or by clicking **View ▸ 3D Mode**.

Within the 3-D View (Figure 2-4), the user can:

- Pan and rotate in 3-D around the IP-S2 project area.

- Zoom in and out of the loaded IP-S2 project area

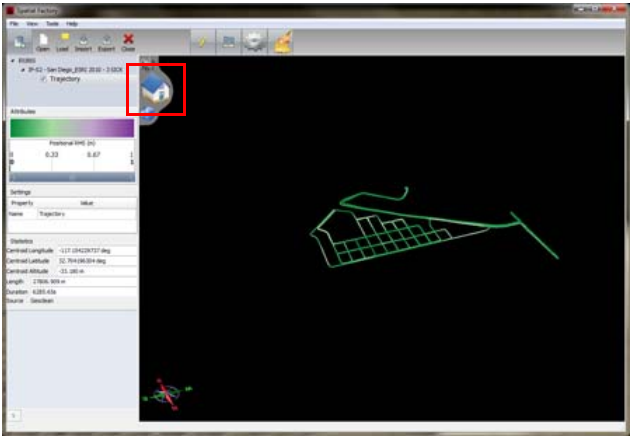


Figure 2-4. 3-D View – House Icon

The Panoramic View

After loading a section of point cloud and images from the trajectory of a dataset, from either the Map or 3-D views, the user can access the spherical images that were collected. A single click on any collected image (blue sphere) displays the image. Double-clicking on a collected image displays the full panoramic image, and the view automatically switches to the Panoramic View (Figure 2-5).

When any image is selected, the user can access the Panoramic View by clicking the **Camera** icon in the project area or by clicking **View ▸ Pano Mode**.

While in the Panoramic View (Figure 2-5), the user can:

- Rotate and zoom 360 degrees from the origin of the camera center
- Rotate the image by clicking and holding the left mouse button

- Zoom in and out by using the scroll wheel

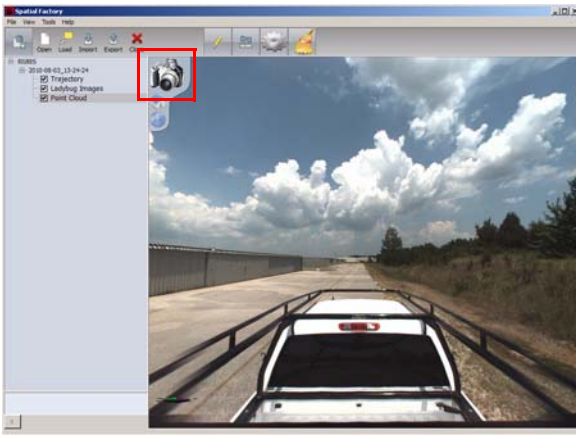


Figure 2-5. Panoramic View – Camera Icon

Defining Preferences

The **Preferences** window enables the user to define program and feature settings. It gives the user some control over how Spatial Factory displays the loaded IP-S2 dataset. It is recommended the user defines these settings before he or she begins using the program features. This section provides explanations of the **Preferences** window tabs.

To access the **Preferences** window, click **File ▸ Preferences** (Figure 2-6).

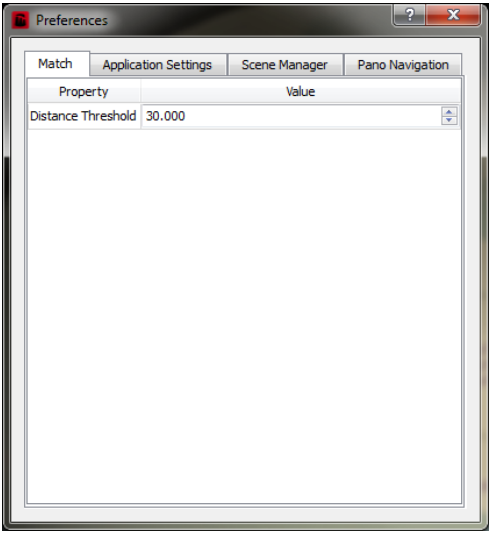


Figure 2-6. Preferences Window – Match Tab

Match Tab

Distance Threshold (in meters) is the only setting on the **Match** tab. This enables the user to specify which control points are selected for use in control point registration. It is recommended to use control points closest to the trajectory. With this setting the user can limit the

distance from the trajectory in which control points are considered viable for registration.

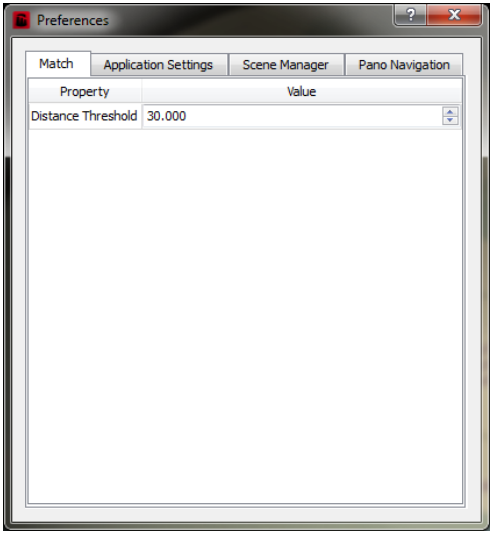


Figure 2-7. Preferences Window – Match Tab

Application Settings Tab

The **Application** tab (Figure 2-8) defines the following items:

- **Point Cloud Density Limit** – This allows the user to select the point cloud density limit (in meters) of the displayed Lidar data when the user loads a section of the vehicle trajectory. The default value is set to 0.05 meters.

  The lower the point cloud density, the denser the point cloud that is loaded by Spatial Factory; however, the amount of the vehicle trajectory that can be loaded at one time decreases.

  The higher the point cloud density, the lower the density of the point cloud that is loaded by Spatial Factory; however, the amount of the vehicle trajectory that can be loaded at one time increases.

- **Distance Units** – This allows the user to select the type of distance unit (metric, decimal feet, or feet and inches) that is displayed in Spatial Factory.

- **Workspace Directory** – This allows the user to select the computer directory location used to save attribute information defined from a collected IP-S2 dataset.
- **Default Coordinate System** – This allows the user to select the coordinate system in which the collected Lidar points are displayed.

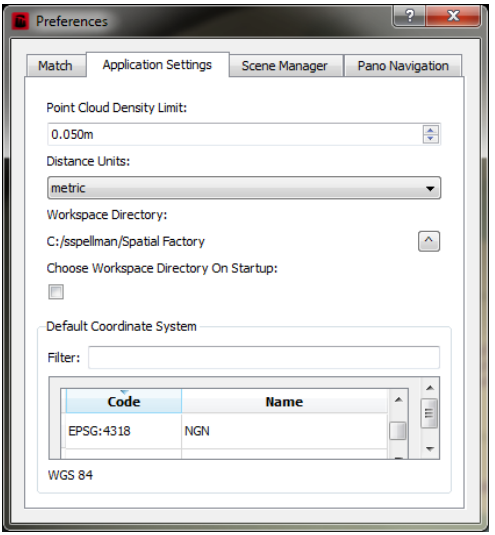


Figure 2-8. Preferences Window – Application Settings Tab

Scene Manager Tab

The **Scene Manager** tab (Figure 2-9) defines the map cache directory on the computer which contains all of the background map information when the user zooms in and out of a particular area on the globe using the Map View.

An active Internet connection is required to see the background map in the Map View.

The map cache directory is useful for importing a background map into the IP-S2 logging software, Spatial Collect, so the user can view

the trajectory the IP-S2 vehicle has taken during the course of the data run overlayed with the background map of the project area.

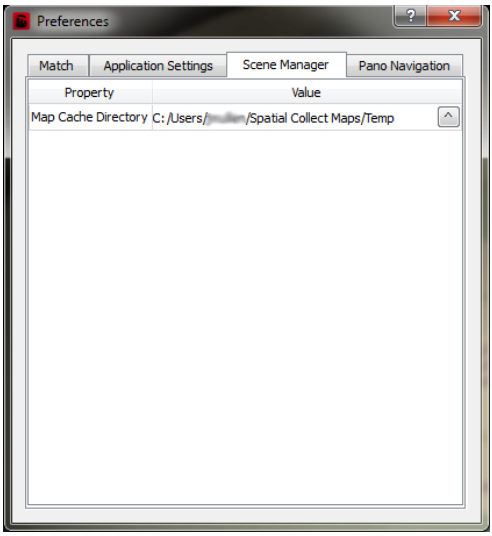


Figure 2-9. Preferences Window – Scene Manager Tab

Panoramic Navigation Tab

The **Panoramic Navigation** tab (Figure 2-8) defines the following items:

- **Auto Load Point** – Select this check box to automatically load point cloud data while traversing through the camera images in the Panoramic View. By default, this check box is not selected.
- **Image Increment** – The image increment setting determines how many images are used to jump forward or backward at one time while traversing through the panoramic view (i.e. when using the up/down arrow buttons). The default value is set to one.
- **Image Load Distance** – The image loading distance controls how far away images are automatically loaded (in meters) on either side of a loaded trajectory as the user traverses through the Panoramic View. The default value is set to 100 meters.

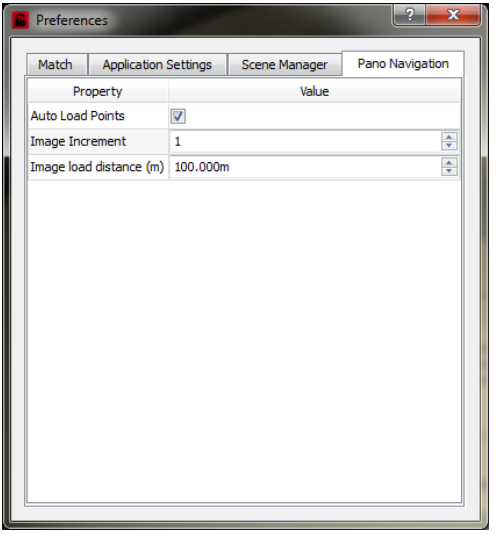


Figure 2-10. Preferences Window – Pano Navigation Tab

Creating, Activating, Deleting, and Copying Workspaces

The workspace enables you to save all of the attribute information, (i.e. distance measurements, created points, lines, polygons, etc.) associated with a given IP-S2 dataset.

This section provides steps for creating, activating, deleting, and duplicating workspaces, which are all features of the **Workspaces** window.

1. Open Spatial Factory.
   The main page appears (Figure 2-11).

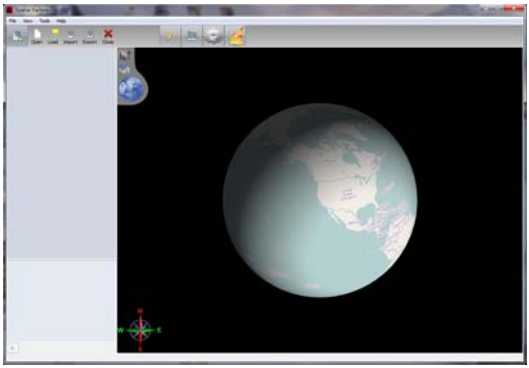


Figure 2-11. Spatial Factory Main Page (Map View)

2. Click **File ▸ Workspaces**.
   The **Workspaces** window appears (Figure 2-12).

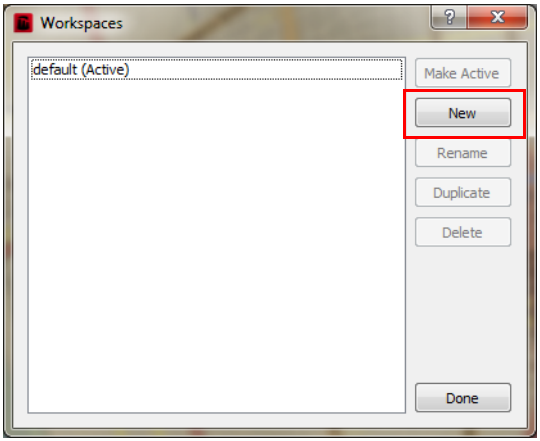


Figure 2-12. Workspaces

3. Click **New** (Figure 2-12).
   The new workspace window appears (Figure 2-13).

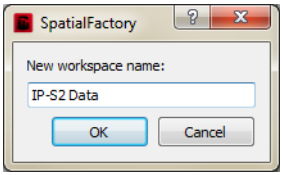


Figure 2-13. New Workspace Window

4. Type a name, and click **OK** (Figure 2-12).
   The Workspaces window reappears with the name of the new workspace displayed in the window (Figure 2-14).

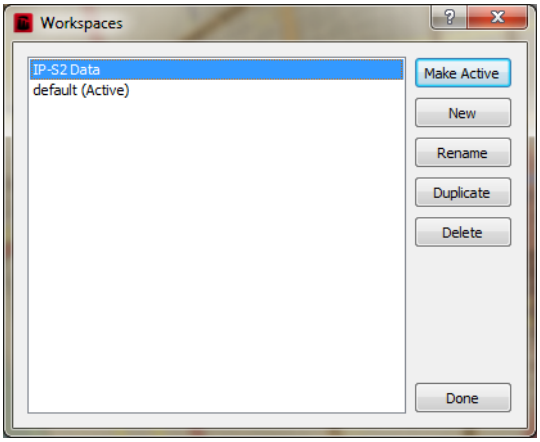


Figure 2-14. Workspaces Window – Make Active

5. To make the new workspace the “active” workspace, select the new workspace, and then click **Make Active** (Figure 2-14).

The word active appears after the name of the active workspace (Figure 2-15).

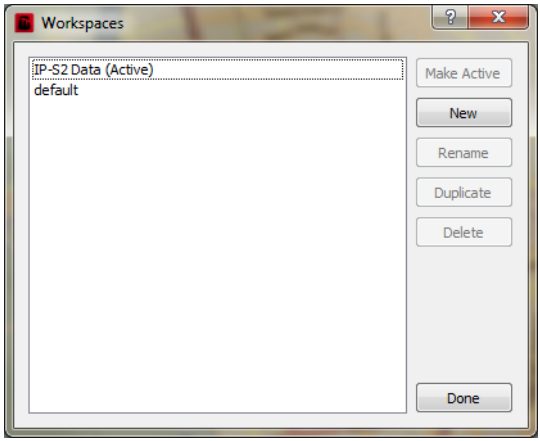


Figure 2-15. Active Workspace

6. To delete a workspace, select it from the **Workspaces** window, click **Delete**, and then click **Yes** when the confirmation window appears.

The user cannot delete an active workspace.

7. To duplicate a workspace, select it from the **Workspaces** window, and click **Duplicate**.
   The new workspace window appears (Figure 2-16).

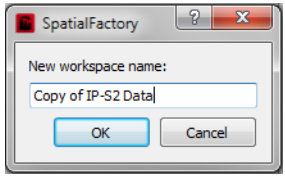


Figure 2-16. New Workspace Window

8. Type a name for the duplicate workspace, and click **OK**. The name of the duplicated workspace appears in the **Workspaces** window (Figure 2-17).

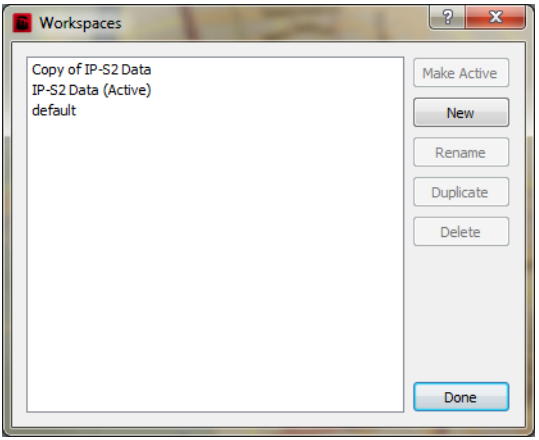


Figure 2-17. Duplicate Workspace

When you are finished, click **Done**.

Loading a Dataset

This chapter describes how to open a dataset, load a trajectory, and colorize a point cloud.

Opening a Dataset and Loading a Trajectory

Once a workspace has been created, the user will want to open a dataset to view or edit the objects in the dataset.

1. Open Spatial Factory.
2. Click the **Open** icon or click **File ▸ Open**.
   The **Browse For Folder** window appears (Figure 3-1).

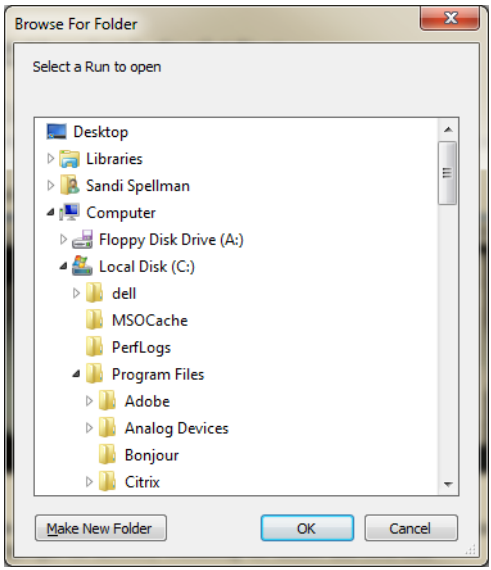


Figure 3-1. Browse For Folder Window

3. Locate the directory that contains the IP-S2 dataset you want to open, select it, and then click **OK** (Figure 3-1).

   The vehicle trajectory begins to load in the Map View. A progress bar appears on the lower left panel (Figure 3-2).

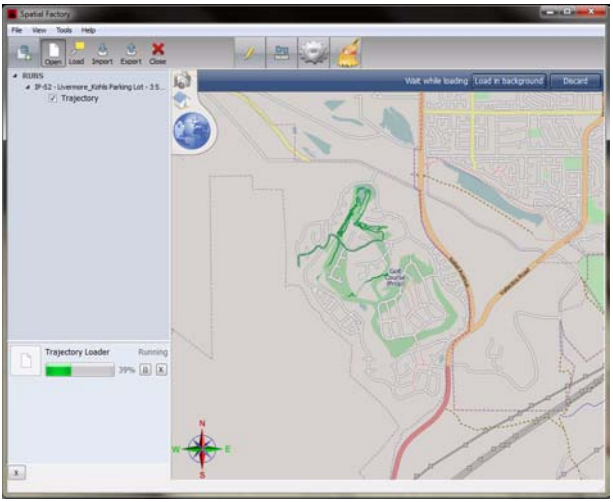


Figure 3-2. Loading the Trajectory

4. To load a segment of the vehicle trajectory:
   1. Zoom in (roll the scroll wheel away from you).
   2. Click the **Load** icon , or click **File ▸ Load**.

3. Click on the trajectory to select a start point, follow the highlighted trajectory, and click to select an end point (Figure 3-3).

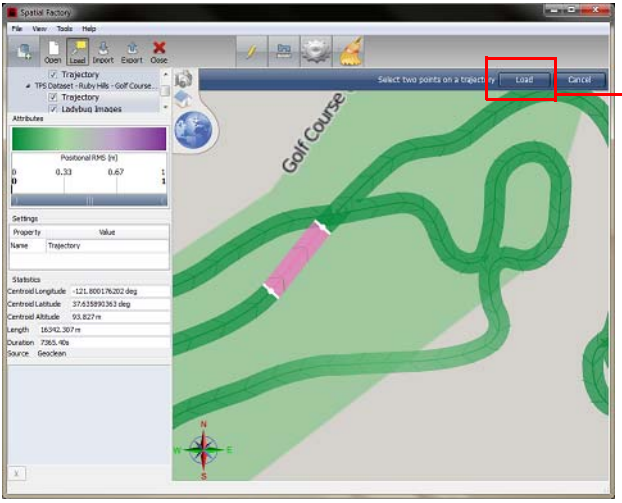


Figure 3-3. Trajectory Segment

4. Once all of the desired segments are selected, click **Load** on the pop-up toolbar (Figure 3-3). This loads the collected point cloud data and camera images. The blue spheres (Figure 3-4) indicate loaded camera images.

In most cases, Spatial Factory cannot load the entire IP-S2 dataset at once. Users can only view sections of the point cloud and image data at one time. If too much of the trajectory is loaded at once, Spatial Factory will load as much of the data as possible before reporting an error.

Figure 3-4. Loaded Dataset with Blue Spheres

5. Click on a blue sphere to display the image as shown in Figure 3-5, or double-click on it to display the full panoramic image as shown in Figure 3-6.

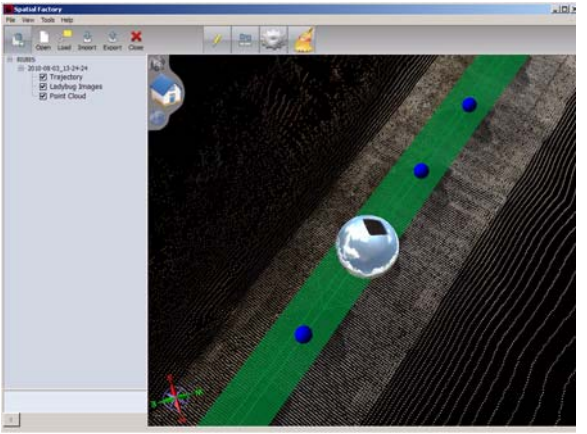


Figure 3-5. Image Display

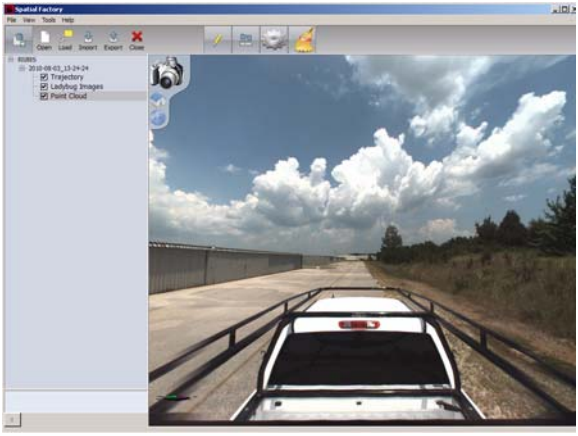


Figure 3-6. Panoramic Image

Colorizing the Point Cloud

Spatial Factory provides various methods for colorizing point cloud data that can be seen in the 3-D and Panoramic views.

1. While in the 3-D or Panoramic views, select **Point Cloud** in the left panel.

   The color method toolbox displays (Figure 3-7).

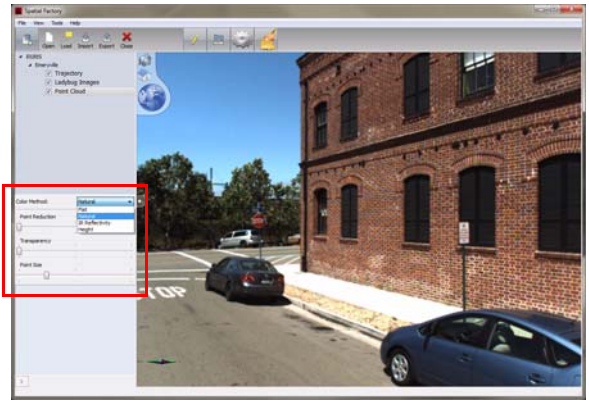


Figure 3-7. Color Method Drop-Down List

2. Select an option from the **Color Method** drop-down list:
   - **Flat** – Using the same color, this displays every point that was collected by the sensors of the IP-S2 system (Figure 3-8).

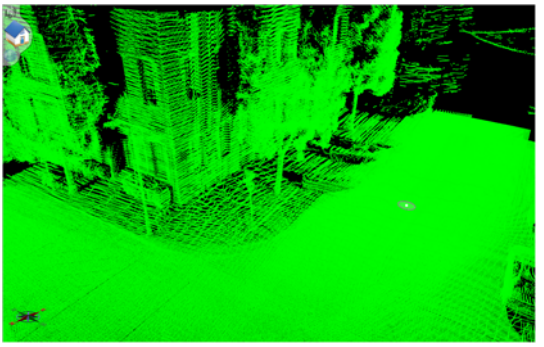


Figure 3-8. Flat Colorization

   - **Natural** – This displays the point cloud data colorized from images collected during the same data run (Figure 3-9).

If the point cloud was not colorized using Geoclean Workstation, Spatial Factory displays the point cloud in a generic RGB color.

Figure 3-9. Natural Colorization

- **IR Reflectivity** – This displays the point cloud data based upon the infrared reflectivity of objects, surfaces, etc. that were scanned during the IP-S2 data run (Figure 3-10).

Figure 3-10. IR Reflectivity Colorization

- **Height** – This displays the point cloud data based upon the relative heights of objects, surfaces, etc. that were scanned during the IP-S2 data run (Figure 3-11).

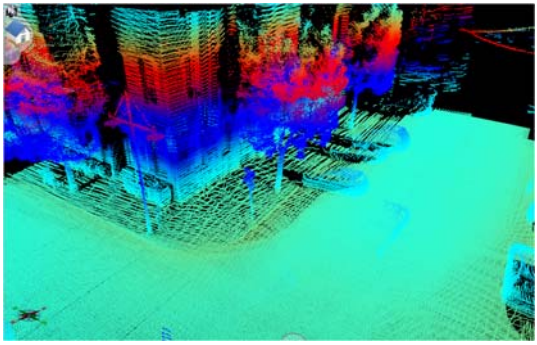


Figure 3-11. Height Colorization

Other Point Cloud Controls

Spatial Factory provides three additional controls for viewing and managing the point cloud characteristics. These controls are typically used while in the Panoramic View.

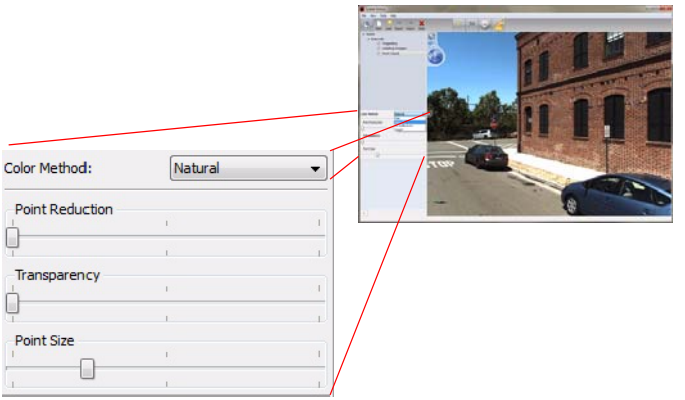


Figure 3-12. Point Cloud Controls

- **Point Reduction** – The Point Reduction slider controls the amount of Lidar points that are displayed on the screen. Slide the bar to the left to increase the amount of visible points. Slide the bar to the right to reduce the amount of visible points. By default, the slider is positioned on the far left to show all of the available points.

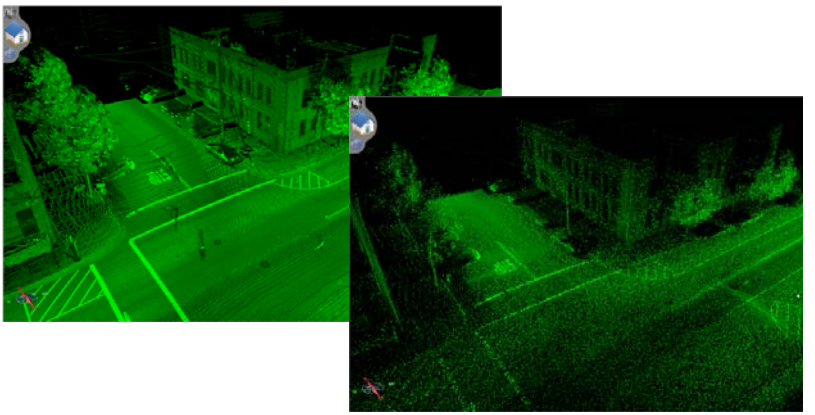


Figure 3-13. Normal View (Left) and Point Reduction (Right)

- **Transparency** – The Transparency slider increases or decreases the visibility of loaded point cloud segment. This is typically used in conjunction with the Panoramic View.

  When the slider is positioned to the far left, the point cloud is not displayed in the Panoramic View. If the slider is moved slightly to the right, the point cloud appears in the Panoramic View with little transparency. Move the slider from left to right to increase the amount of transparency of the point cloud as desired.

Figure 3-14. Low Transparency (Left) and High Transparency (Right)

- **Point Size** – The Point Size slider increases the size of the vertices of all of the points for the loaded point cloud segment.

Move the slider from left to right to increase the size of the points that are displayed.

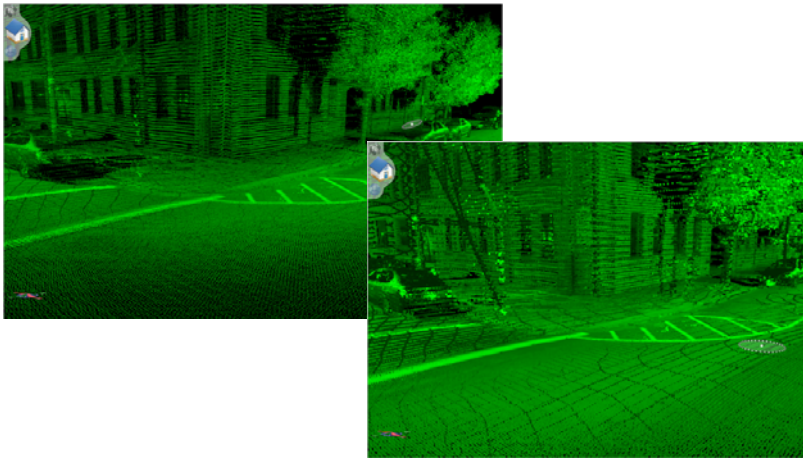


Figure 3-15. Small Point Size (Left) and Large Point Size (Right)

Importing and Exporting Files

This chapter describes how to import files, such as control points, attribute sets, etc. and how to export vehicle trajectories, point clouds, and attributes.

Importing Files

The user can import a variety of files, including Geo-database feature codes and attribute sets. These are imported using shapefiles (in .shp format) as well as ASCII data, such as control points (for control point registration) or point cloud data in .txt, .csv, or .tsv file formats.

Importing ESRI Shape Files

To import shapefiles into Spatial Factory, do the following:

1. Open an IP-S2 dataset, by clicking the **Open** icon or click **File ▸ Open**.
2. On the **Browse For Folder** window, locate the directory that contains the IP-S2 dataset the user wants to import, select it, and then click **OK**.
3. Click the **Import** icon or click **File ▸ Import**.

The **Choose Import File** window appears (Figure 4-3).

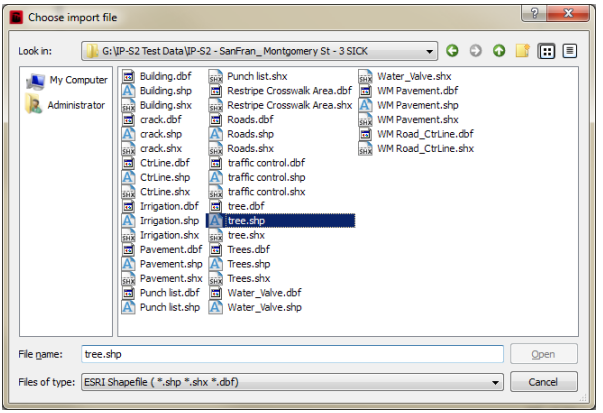


Figure 4-1. Choose Import File Window

4. Locate the shapefile on the computer directory, select it, and click **Open**.

It is only necessary to select the .shp file when importing shapefiles into Spatial Factory. All related files (**.shx**, **.dbf**, and **.prj**) are automatically imported.

The shapefile now appears as a layer under **Markings** in the left panel (Figure 4-2).

If there is not a .prj file in the directory where the imported shape files are located, Spatial Factory prompts the user to select the appropriate coordinate system that corresponds to the attribute data contained in the imported shape file.

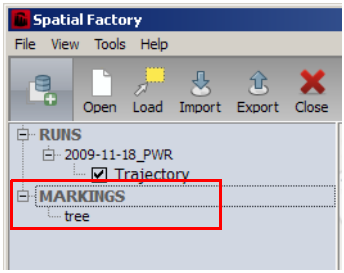


Figure 4-2. Left Panel – Shapefile

Importing ASCII Files

The user can import ASCII coordinate files that contain control point information (for using the control point registration feature) or point cloud data with .txt, .csv, or .tsv file extensions.

If the user is importing an ASCII file of coordinates using .txt and .csv file extensions, Spatial Factory requires the imported file to be in Longitude, Latitude, Ellipsoid Height format (not Latitude, Longitude, Ellipsoid Height).

To import ASCII files into Spatial Factory, do the following:

1. Open an IP-S2 dataset, by clicking the **Open** icon or click **File ▸ Open**.
2. On the **Browse For Folder** window, locate the directory that contains the IP-S2 dataset the user wants to import, select it, and then click **OK**.

3. Click the **Import** icon or click **File ▸ Import**.
   The **Choose Import File** window appears (Figure 4-3).

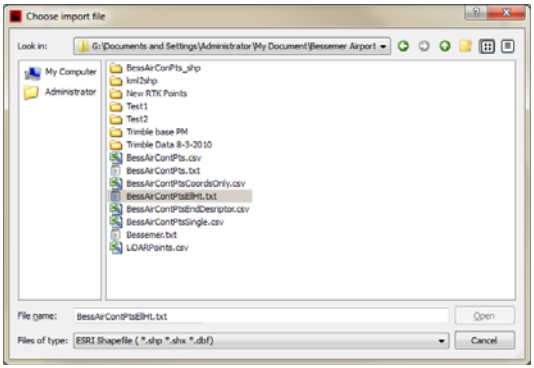


Figure 4-3. Choose Import File Window

4. Locate the ASCII file on the computer directory, select it, and click **Open** (Figure 4-3).

   Because ASCII files do not contain projection information, Spatial Factory prompts the user to select the coordinate system of the input file (Figure 4-4).

Figure 4-4. Select Coordinate System Window

5. Select the appropriate coordinate system, and click **Import**.
   The ASCII point file name appears as a layer under **Markings** in the left panel (Figure 4-5). Any existing points contained in the file are listed and appear on the map.

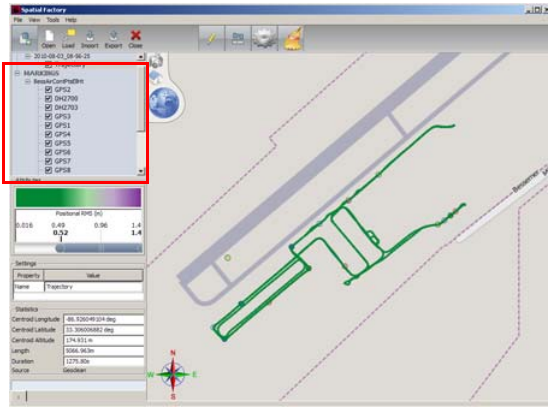


Figure 4-5. The ASCII Point File Name is Listed Under Markings

Exporting Files

The user can export the vehicle trajectory information from the IP-S2 dataset, the point cloud data, and the attribute information that was collected.

Exporting the Vehicle Trajectory

To export the vehicle trajectory using Spatial Factory, do the following:

1. Open an IP-S2 dataset, by clicking the **Open** icon or click **File ▸ Open**.
2. On the **Browse For Folder** window, locate the directory that contains the IP-S2 dataset the user wants to export, select it, and then click **OK**.

3. Click the **Export** icon or click **File ▸ Export**.
   The left-panel project library appears (Figure 4-6).

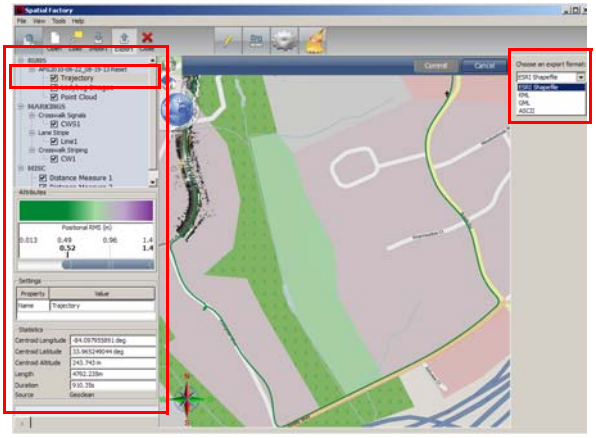


Figure 4-6. Project Library – Trajectory

4. Select **Trajectory** in the project library.
   The **Choose an file format** drop-down menu appears in the right panel (Figure 4-6).
5. Select an export format, and then click **OK**.

Spatial Factory can export the vehicle trajectory in the following file extensions: **.shp**, **.kml**, **.gml**, or as an **ASCII**.

A dialog box appears in the right panel, prompting the user to select the appropriate coordinate system in which to export the vehicle trajectory (Figure 4-7).

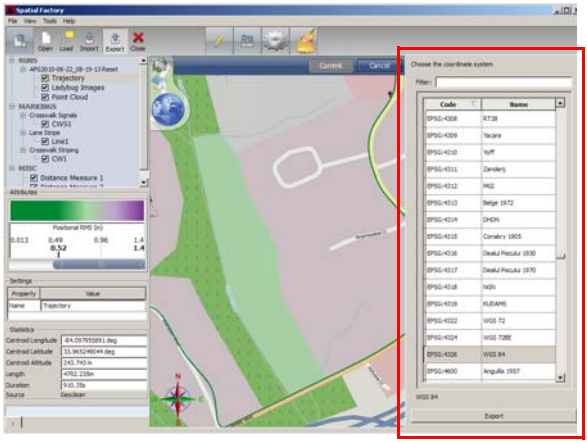


Figure 4-7. Coordinate System Window

6. Select the appropriate coordinate system, and click **Export**.

When exporting the vehicle trajectory to .kml format, Spatial Factory automatically sets the coordinate system to WGS84. No user selection is required.

The **Choose Export File Name** window appears (Figure 4-8).

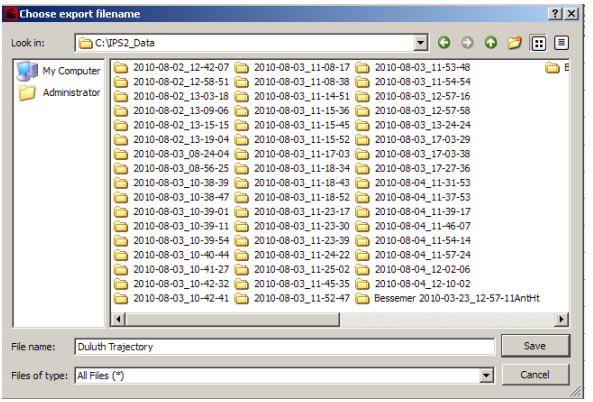


Figure 4-8. Choose Export File Name Window

7. Select a directory into which the user will export the vehicle trajectory, and then click **Save**.

Exporting the Point Cloud Data

The user can export point cloud data from the IP-S2 dataset to use in a third-party Lidar analysis and management program. Spatial Factory exports the currently loaded point cloud data with the following file extensions: **.ips**, **.csv**, and **.las**.

To export the currently loaded point cloud data using Spatial Factory, do the following:

1. Open an IP-S2 dataset, by clicking the **Open** icon or click **File ▸ Open**.
2. On the **Browse For Folder** window, locate the directory that contains the IP-S2 dataset the user wants to export, select it, and then click **OK**.

3. Click the **Export** icon or click **File ▸ Export**.
   The **Choose Export File** window appears (Figure 4-3).
   The left-panel project library appears.

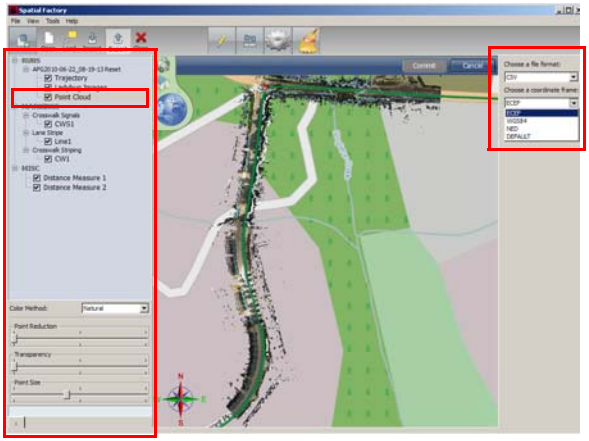


Figure 4-9. Project Library – Point Cloud

4. Select **Point Cloud** in the project library (Figure 4-9).
   The **Choose a file format** and **Choose a coordinate format** drop-down menus appear in the right panel (Figure 4-6).
5. Select an export format and a coordinate system from the drop-down lists, and then click **Export**.

Depending on the selected file format, Spatial Factory can currently only export point cloud data in ECEF (Earth-Centered Earth Fixed) coordinates or WGS84 Latitude/Longitude/Ellipsoid height.

The **Choose Export File Name** window appears (Figure 4-10).

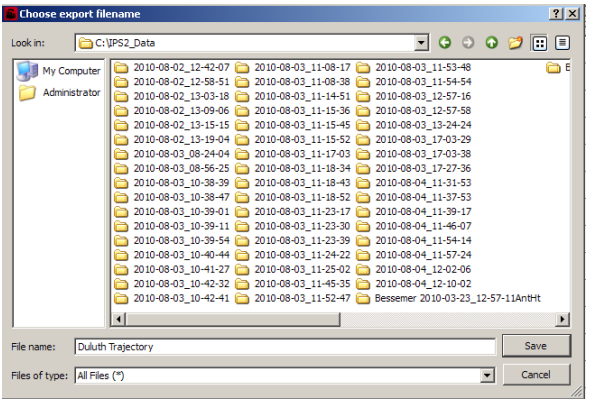


Figure 4-10. Choose Export File Name Window

6. Select a directory into which the user will export the point cloud data, and then click **Save**.

Exporting the Attribute Data

To export attribute data using Spatial Factory, do the following:

1. Open an IP-S2 dataset, by clicking the **Open** icon or click **File ▸ Open**.
2. On the **Browse For Folder** window, locate the directory that contains the IP-S2 dataset the user wants to export, select it, and then click **OK**.

3. Click the **Export** icon or click **File ▸ Export**.
   The left-panel project library appears (Figure 4-6).

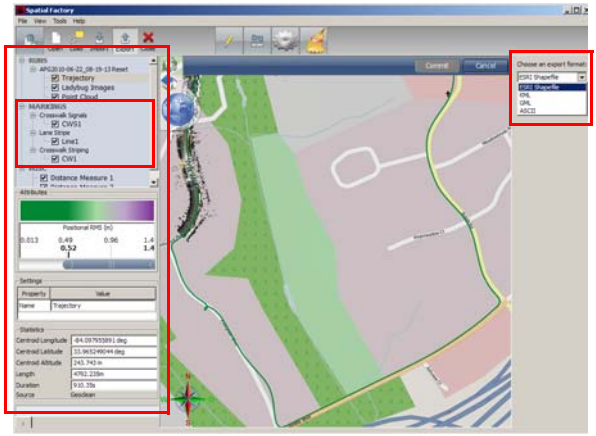


Figure 4-11. Project Library – Trajectory

4. Under **Markings** in the project library, select the feature set you want to export.
   The **Choose an export format** drop-down menu appears in the right panel (Figure 4-6).
5. Select an export format, and then click **OK**.

Spatial Factory can export attribute data with the following file extensions: **.shp**, **.kml**, **.gml**, or **ASCII**.

A dialog box appears in the right panel, prompting the user to select the appropriate coordinate system in which to export the attribute data (Figure 4-7).

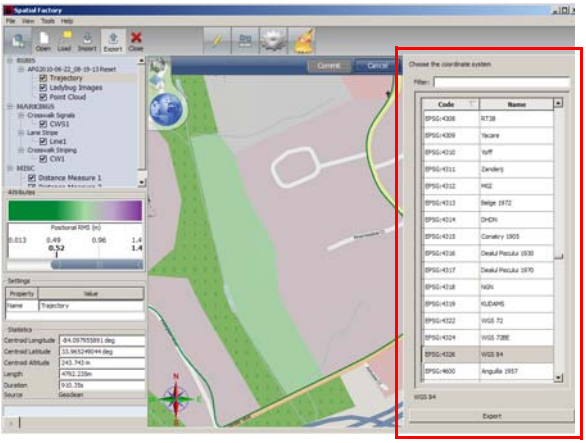


Figure 4-12. Coordinate System Window

6. Select the appropriate coordinate system, and click **Export**.

When exporting the attribute data to .kml format, Spatial Factory automatically sets the coordinate system to WGS84. No user selection is required.

The **Choose Export File Name** window appears (Figure 4-8).

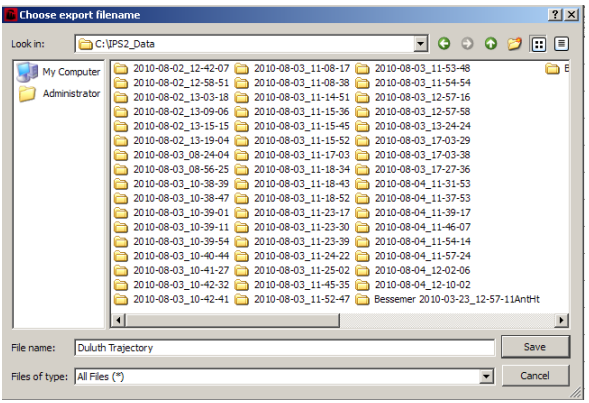


Figure 4-13. Choose Export File Name Window

7. Select a directory into which the user will export the vehicle trajectory, and then click **Save**.

Notes:

Creating Attributes

This chapter describes how to create and identify a variety of attributes (i.e. light poles, fire hydrants, road signs, electric lines, trees, etc.) from the collected IP-S2 dataset. Currently, Spatial Factory allows you to create individual points, lines, and polygons, and measure distances between points.

Creating Points

To create new points and point layers from collected IP-S2 data, do the following:

1. Open an IP-S2 dataset. See "Opening a Dataset and Loading a Trajectory" on page 3-1.
2. Click **Tools** ▸ **Points** or click the **Pencil** icon and then the **Points** icon . (Double-click on the **Points** icon to create multiple points)
   The pop-up toolbar appears at the top of the project area.

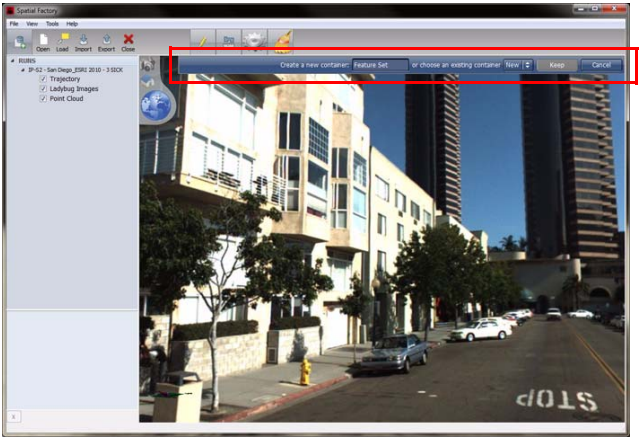

Spatial Factory
File View Tools Help
Open Load Import Export Close
RUNS
IP-S2 - San Diego_ESRI 2010 - 3 SICK
Trajectory
Ladybug Images
Point Cloud
Create a new container: Feature Set or choose an existing container New Keep Cancel

Figure 5-1. Pop-Up Toolbar – Container Name

3. On the pop-up toolbar, enter a name for the point container (layer) or select an existing container.
4. Click on the map where you want to add a point.
5. On the pop-up toolbar, enter a point name or use the default, and then click **Keep**.

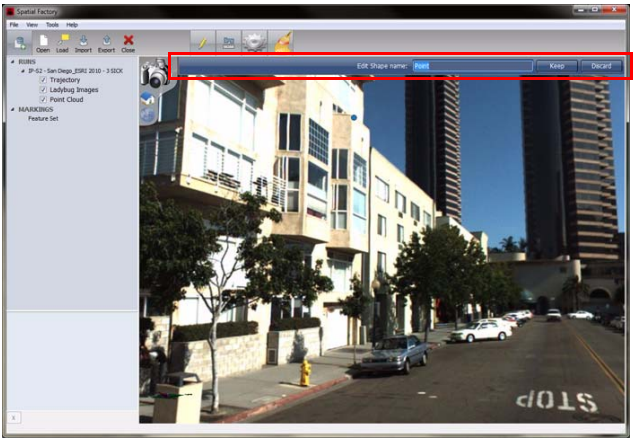


Figure 5-2. Pop-Up Toolbar – Point Name

The **Settings** and **Statistics** boxes appear in the left panel (Figure 5-3).

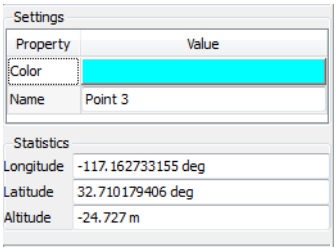


Figure 5-3. Settings and Statistics Boxes

6. To modify the point color, click in the **Color Value** field, select a color from the **Select a color** window (Figure 5-4), and then click **OK**.

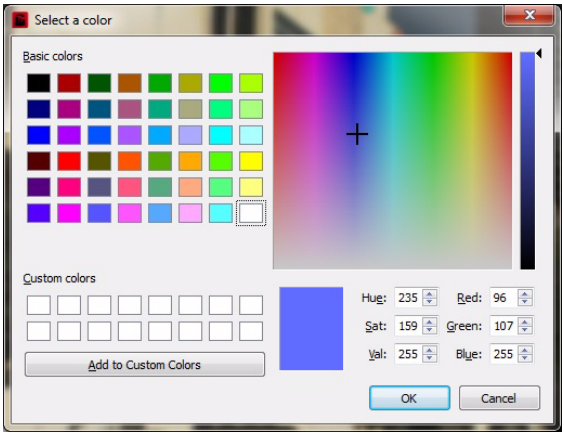


Figure 5-4. Select a Color Window

The **Color Value** field displays the selected color.

7. To change the point name, click in the **Name Value** field, type a new name, and press **Enter.**

Creating Lines

To create new lines and line layers from collected IP-S2 data, do the following:

1. Open an IP-S2 dataset. See “Opening a Dataset and Loading a Trajectory” on page 3-1.
2. Click **Tools** ▸ **Lines** or click the **Pencil** icon and then the **Lines** icon .
   The pop-up toolbar appears at the top of the project area.

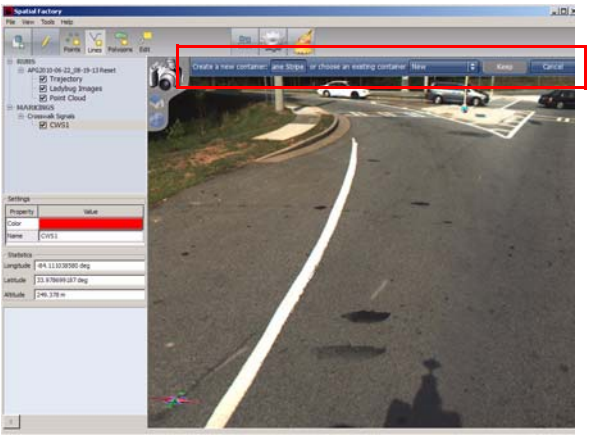
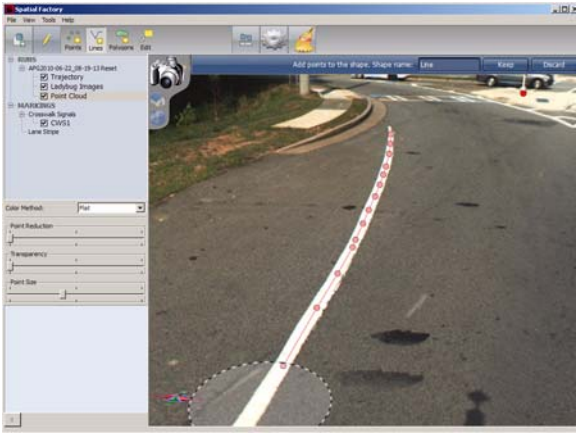


Figure 5-5. Pop-Up Toolbar – Container Name

3. On the pop-up toolbar, enter a name for the line container (layers) or select an existing container.

4. Click on the map to place the line start point, and continue to click on the map to select the line vertices.



Shift+click on a point in the project area to add a vertex.

Figure 5-6. Creating Line Vertices

When the final point in the line is selected, the user can edit the line name in the pop-up toolbar. The collected line now appears under the designated container (layer) in the project library.

The **Settings** and **Statistics** boxes appear in the left panel (Figure 5-7).

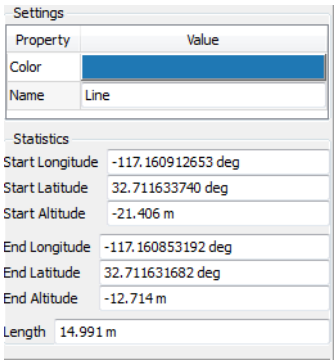


Figure 5-7. Settings and Statistics Boxes

5. To change the line color, click in the **Color Value** field in the left panel, select a color from the **Select a color** window (Figure 5-8), and then click **OK**.

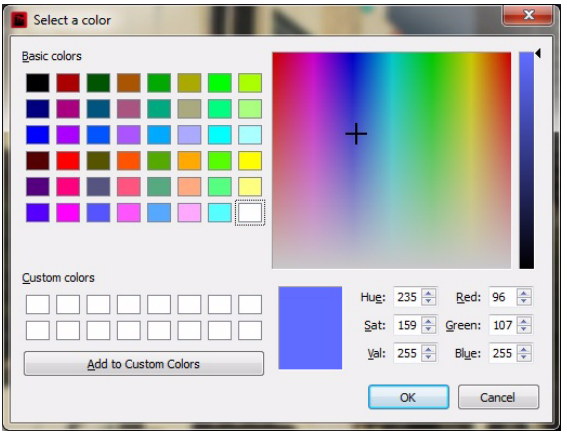


Figure 5-8. Select a Color Window

The **Color Value** field displays the selected color.

6. To change the line name, click in the **Name Value** field, type a new name, and press **Enter.**
7. When you are finished, click **Keep** in the pop-up toolbar to save the line or **Discard** to delete it.

Creating Polygons

To create new polygons and polygon layers from collected IP-S2 data, do the following:

1. Open an IP-S2 dataset. See “Opening a Dataset and Loading a Trajectory” on page 3-1.
2. Click **Tools** ▸ **Polygons** or click the **Pencil** icon and then the **Polygons** icon .
   The pop-up toolbar appears at the top of the project area.

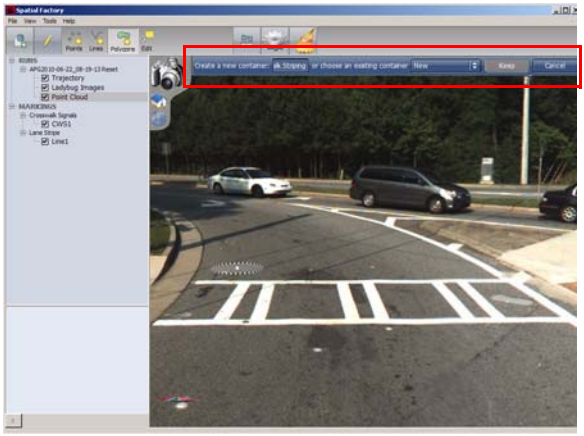


Figure 5-9. Pop-Up Toolbar – Container Name

3. On the pop-up toolbar, enter a name for the polygon container (layers) or select an existing container.
4. Click on the map to place the polygon start point, and continue to click on the map to select the polygon vertices (Figure 5-10). The pop-up toolbar changes, and the polygon becomes highlighted as it is created.

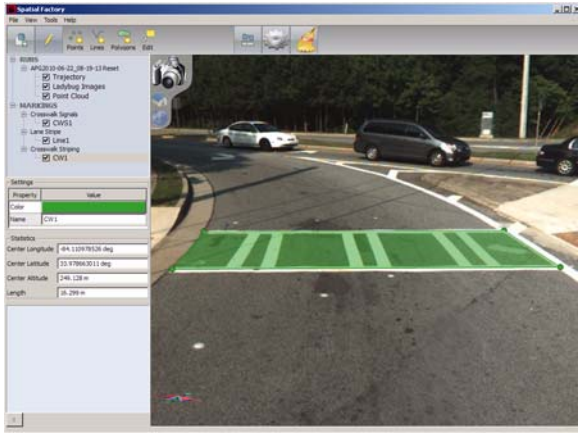


Figure 5-10. Creating Polygon Vertices

5. When the final point in the polygon is selected, the user can edit the polygon name in the pop-up toolbar and then click **Keep** to record the polygon/shape or **Discard** to delete it. The polygon now appears under the designated container (layer) in the project library.

   The **Settings** and **Statistics** boxes appear in the left panel (Figure 5-11).

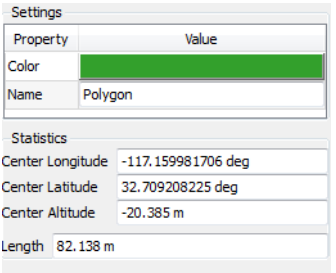


Figure 5-11. Settings and Statistics Boxes

6. To change the polygon color, click in the **Color Value** field, select a color from the **Select a color** window (Figure 5-12), and then click **OK**.

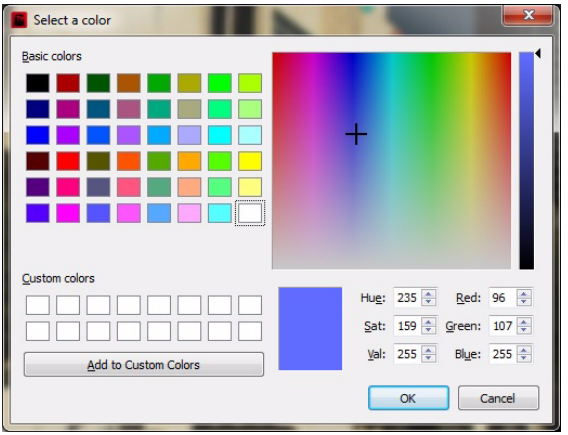


Figure 5-12. Select a Color Window

   The **Color Value** field displays the selected color.

7. To change the polygon name, click in the **Name Value** field, type a new name, and press **Enter**.

Creating Distance Measurements

To measure the distance between points from collected IP-S2 data, do the following:

1. Open an IP-S2 dataset. See “Opening a Dataset and Loading a Trajectory” on page 3-1.
2. Click **Tools** ▸ **Measure** or click the **Ruler** icon and then the **Measure** icon .
3. Click on the point cloud to select the starting point of the distance measurement, and then click to select the end point. The distance between the two points automatically appears (Figure 5-13).

Figure 5-13. Measuring Distance

4. To display detailed information about the distance measurement, select the blue arrow to the left of the calculated distance value (Figure 5-14).

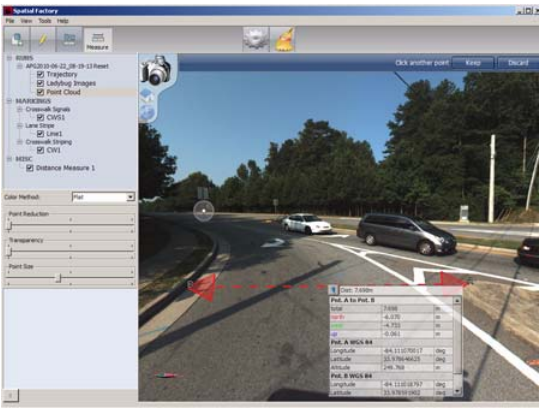


Figure 5-14. Distance Value Information

5. Continue to select as many points as necessary in the point cloud to calculate the distance.
6. When you are finished and the final point in the line is selected, click **Keep** or **Discard** in the pop-up toolbar.

   The distance measurement now appears in the project library under the MISC heading (Figure 5-14).
   The user can continue collecting distance measurements between points in the point cloud as necessary.

7. To change the line color, click in the **Color Value** field in the left panel, select a color from the **Select a color** window (Figure 5-15), and then click **OK**.

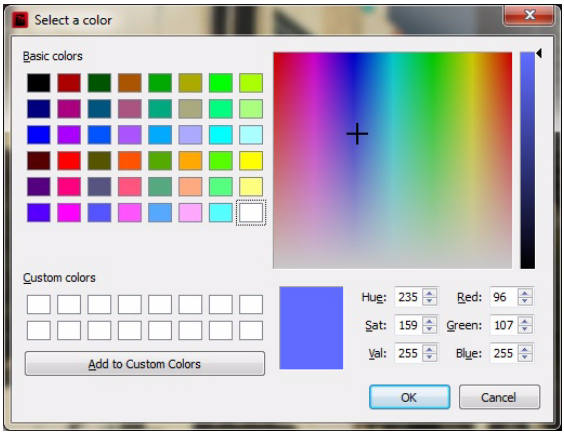


Figure 5-15. Select a Color Window

The **Color Value** displays the selected color.

8. To change the line name, click in the **Name Value** field, type a new name, and press **Enter.**

Editing Points, Lines, and Polygons

To edit an existing point, line, or polygon, do the following:

1. Open an IP-S2 dataset. See “Opening a Dataset and Loading a Trajectory” on page 3-1.
2. To edit existing points, click **Tools** ▸ **Edit** or click the **Pencil** icon and then the **Edit** icon .
3. Select the desired point, line, or polygon from the project library in the left panel.
4. To add a vertex to a line or polygon, **Shift**+click on the location for the new vertex.
   A new vertex appears.

5. To remove a vertex, **Ctrl**+click on the end of the vertex to remove it.
6. When you are finished making edits, click **Commit** on the pop-up toolbar to record the changes.

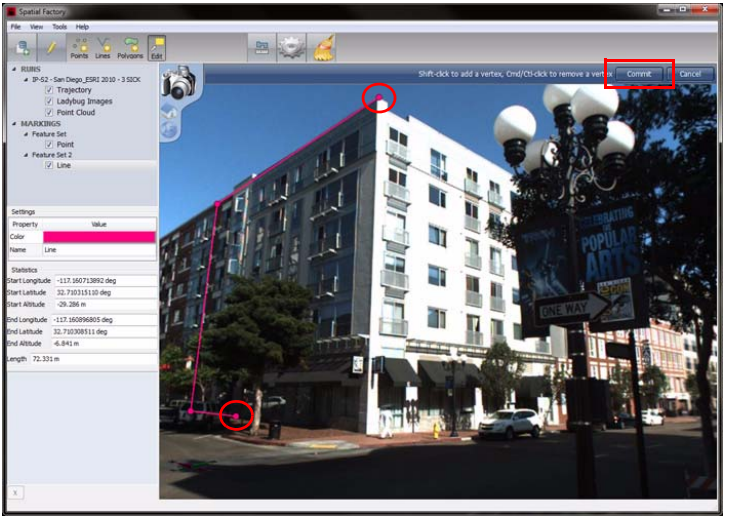


Figure 5-16. End Points and Commit Button

Control Point Registration

Control point registration improves the accuracy of a given vehicle trajectory by correlating known control points (most likely collected with survey-grade GNSS equipment) with certain points collected by the Lidar scanner that are approximately at the same location.

The types of control points are usually of stable objects that are easily identifiable and displayed within the point cloud, such as road lines, manholes, fire hydrants, etc.

When performing this procedure, the minimum number of control points required is three and while there is no maximum number, for best results, use as many control points as possible.

Step 1: Opening a Dataset

1. Click the **Open** icon or click **File** ▸ **Open**.
   The **Browse For Folder** window appears (Figure 6-1).

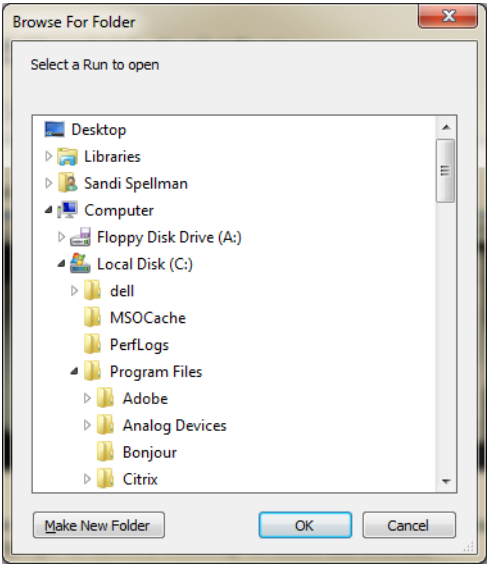


Figure 6-1. Browse For Folder Window

2. Locate the directory that contains the IP-S2 dataset, select it, and then click **OK** (Figure 6-1).

   The vehicle trajectory begins to load in the Map View (Figure 6-2).

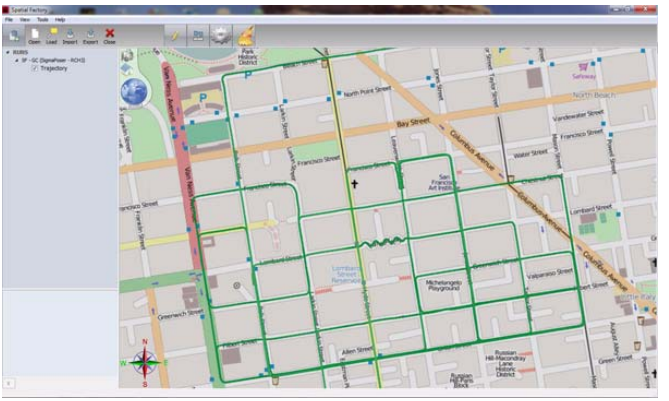


Figure 6-2. The Vehicle Trajectory is Marked in Green

Step 2: Importing Collected Control Points

(Continued from Step 1)

1. Click **File ▸ Import**.
   The **Choose import file** window appears (Figure 6-3).

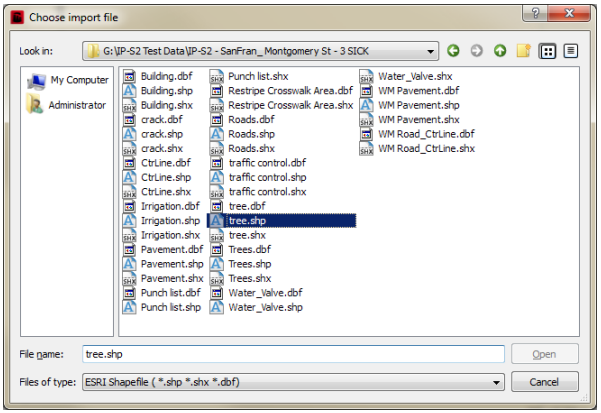


Figure 6-3. Choose Import File Window

2. Select the ESRI shape file or ASCII file that contains the coordinate information on the collected control points within the IP-S2 project area, and then click **Open**.

NOTE

If the user is importing an ASCII file of coordinates (in .txt or .csv formats) Spatial Factory requires the imported file format to be in Longitude, Latitude, Ellipsoid Height (not Latitude, Longitude, Ellipsoid Height).

NOTE

If the user is importing an ASCII file or if the .prj projection file does not exist with the imported ESRI shapefile, Spatial Factory prompts the user to choose the appropriate coordinate system in which the imported points have been collected.

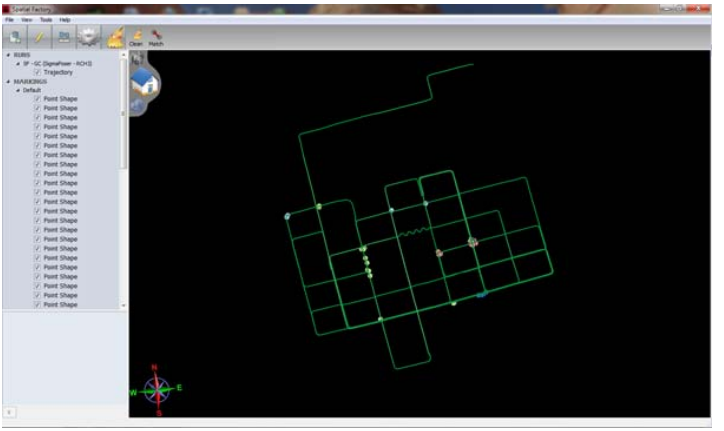


Figure 6-4. Imported Control Points in 3-D View

Step 3: Control Point Registration

(Continued from Step 2)

1. Open an IP-S2 dataset. See “Opening a Dataset and Loading a Trajectory” on page 3-1.
2. Click **Tools ▸ Match**.
   The pop-up toolbar changes.
3. Load a section of the point cloud that contains imported control points.
   This section of point cloud is loaded on the Map View.

When performing control point registration, Spatial Factory only loads one vehicle trajectory at a time.

4. Select a control point from the list in the left panel (Figure 6-4).

5. Click on the point it actually represents within the point cloud.

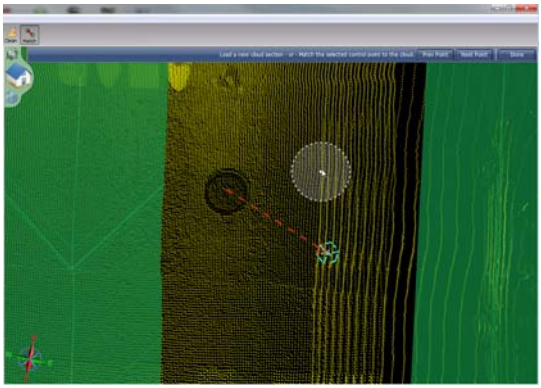


Figure 6-5. Control Point (Surrounded by the Blue Cube)

In Figure 6-5, the control point that was collected in the field (enclosed by the blue cube) was the center of the manhole that is shown in the point cloud. The control point was selected first from the list in the left panel, and then the point it represents within the point cloud was selected.

6. Continue to match the control points with the corresponding point in the point cloud as necessary.
7. The user can load a new section within the dataset from the same or a different trajectory and register control points in that location.

The control point registration for a particular control point is only applied to the selected vehicle trajectory and associated section of point cloud that is loaded during the procedure.

In an IP-S2 dataset where there are multiple vehicle trajectories that have adequately scanned the same control point location but at different time stamps and GNSS conditions, for the best results, it is recommended to associate the same control point to any and all trajectories that have adequately scanned a given control point location within the point cloud.

8. Once all collected control points within the project area have been matched to their respective locations, click **Done** on pop-up toolbar.
   The constraint set accumulates in the left panel during this process.

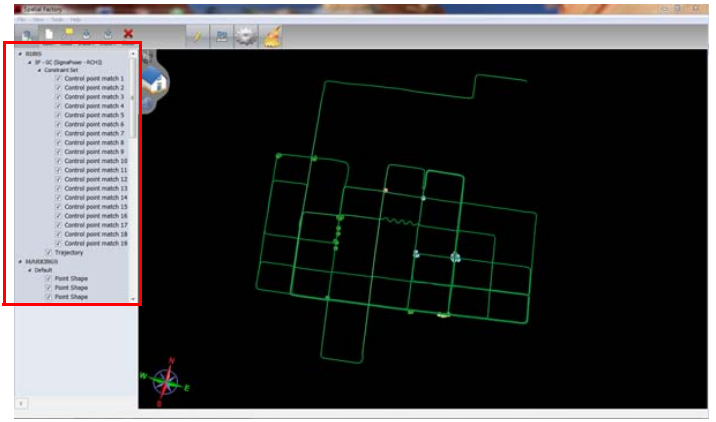


Figure 6-6. Constraint Set

Step 4: Cleaning the Dataset

(Continued from Step 3)

1. To clean the dataset after performing the control point registration, click **Tools ▸ Clean**.
2. Under **RUNS** within the project library, select the dataset in which you want to clean.
3. In the right panel, select the inertial post-processing type that was performed originally when the data was processed using Geoclean.
4. Make sure the **Use Filter Constraints** check box is selected.
5. Click **Clean** on the pop-up toolbar.

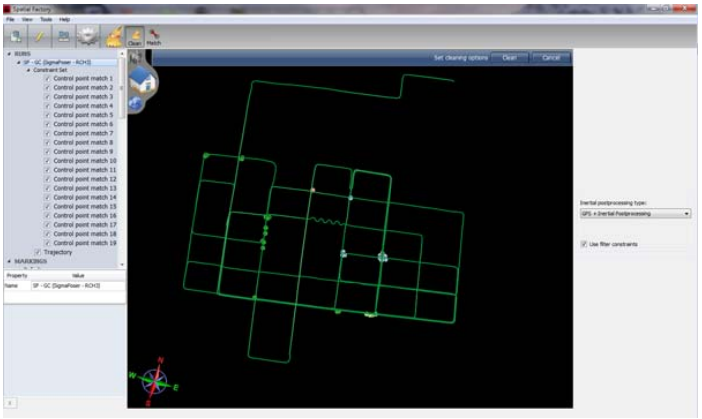


Figure 6-7. Cleaning the Dataset

The cleaning process takes several minutes to complete. The longer the data run, the longer it takes to generate a new trajectory based upon the control point constraints. Once finished, the user

can view the old trajectory and the new trajectory together to see what changes were made due to the control point registration.

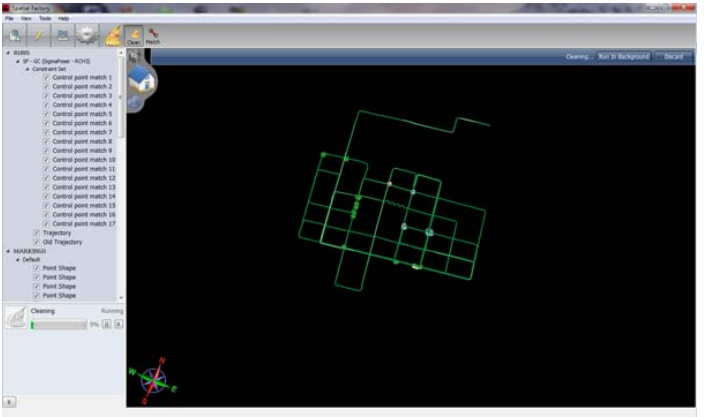


Figure 6-8. Cleaned Dataset

Calibrating the Camera

Camera calibration provides a method for users in the field to align the collected point cloud data with the collected camera images if these two items do not match up for a given IP-S2 dataset. Once the camera calibration is successfully completed and the point cloud and images are properly aligned, Spatial Factory generates a new calibration file that you can load into the IP-S2 using the Web interface, so future IP-S2 datasets that have been collected do not require the camera to be calibrated again until it is necessary.

To perform the camera calibration:

1. Open Spatial Factory.
2. Click the **Open** icon or click **File ▸ Open**.
   The **Browse For Folder** window appears (Figure 7-1).

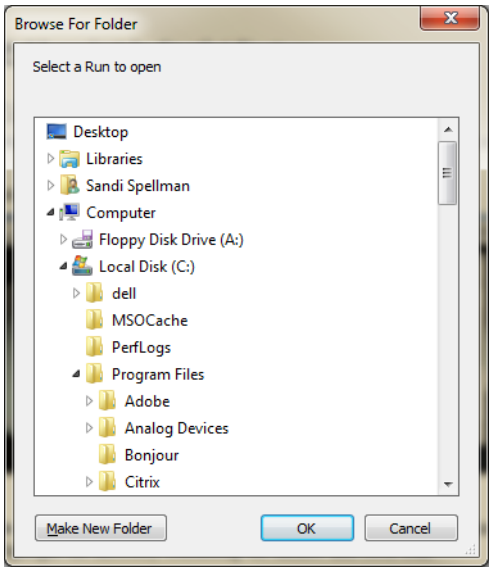


Figure 7-1. Browse For Folder Window

3. Locate the directory that contains the IP-S2 dataset, select it, and then click **OK** (Figure 7-1).
   The vehicle trajectory begins to load.

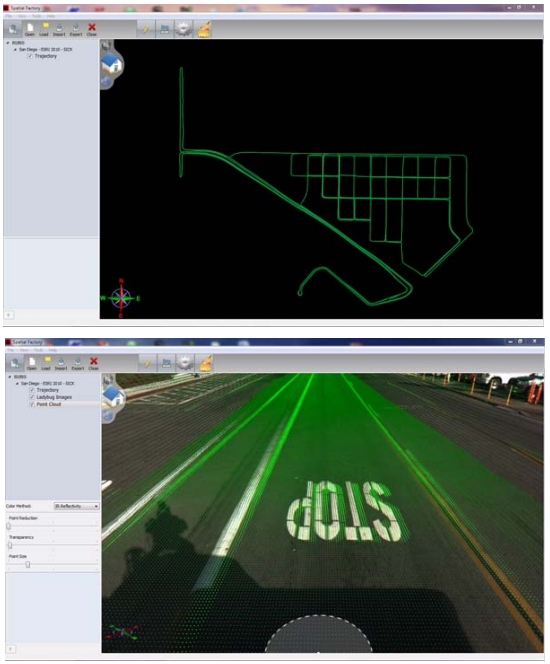


Figure 7-2.

In Figure 7-2, the point cloud data and the collected camera image do not align.

4. Click **Tools ▸ Calibrate**.

5. From the **Choose Run** drop-down list in the right panel, select the IP-S2 dataset upon which the camera calibration will be performed (Figure 7-3).

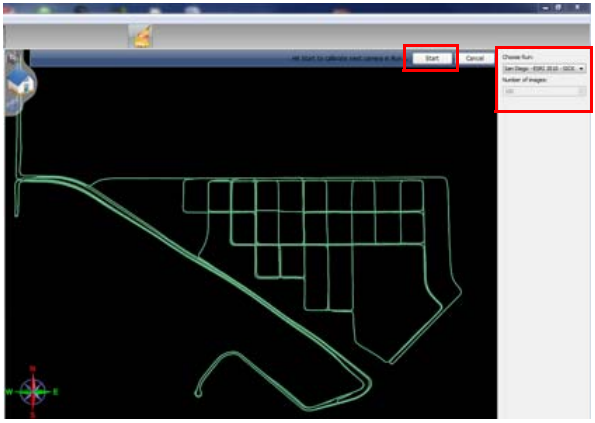


Figure 7-3.

6. When finished, click **Start** on the pop-up toolbar (Figure 7-3).

   The **Image Sequence Loader** progress bar appears in the left panel as Spatial Factory loads all of the images (blue spheres) that were collected in the dataset (Figure 7-4).

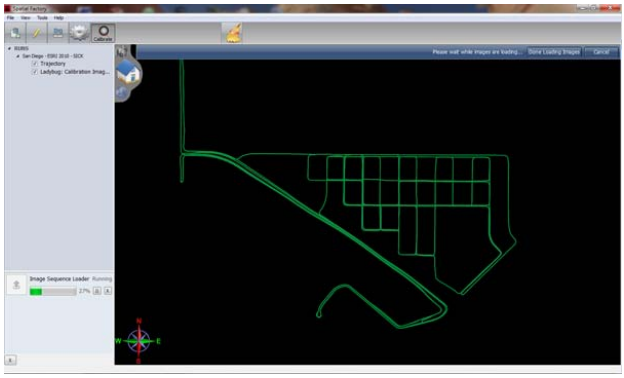


Figure 7-4.

Creating Constraints

When creating constraints, associate points within the section of point cloud loaded for a particular camera image that are as close as possible to the location of the vehicle within the camera image. This produces the most accurate results.

1. Zoom in on one of the trajectories, and double-click on an image.

   This opens the **Panoramic View** (Figure 7-5).
2. In the Panoramic View, create constraints that will be used to calibrate the camera. To do this:
   1. Select a Lidar point from the point cloud that was loaded.
   2. As approximate as possible, select the same point within the camera image.

The types of objects that work best for camera calibration are objects that have defined edges. This makes it easier to identify their location in the point cloud within the image. These objects include building edges, man holes, road lines, crosswalks, turning lane arrows, text, and other objects painted on the road.

3. Repeat this process as necessary for as many images as desired within the IP-S2 dataset.

When performing this procedure, the minimum number of constraints required is three and while there is no maximum number, for best results, use as many constraints as possible

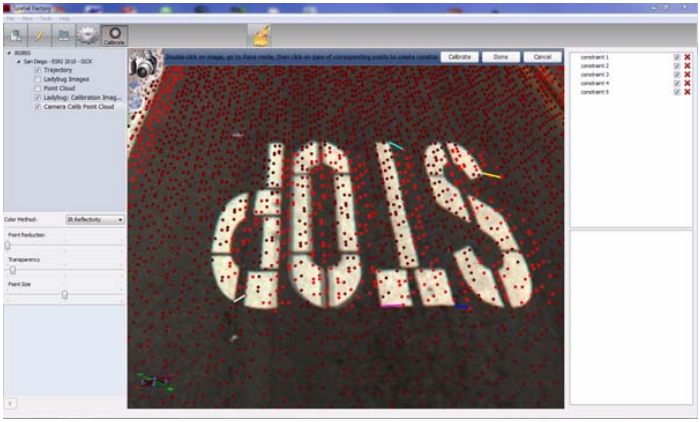


Figure 7-5. Aligning Points Within the Point Cloud and Camera Image

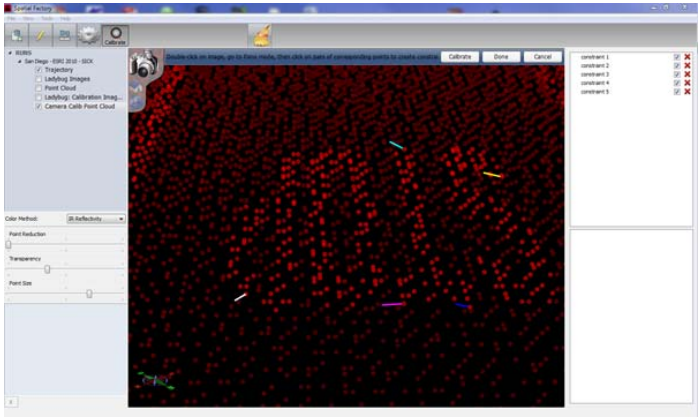


Figure 7-6. Constraints

4. Once all of the desired constraints have been created, click **Calibrate** from the pop-up toolbar. If the calibration was successful, all of the regression statistics appear in the lower portion of the right-side panel.

5. Click **Done** on the pop-up toolbar to save a new calibration file to the computer.

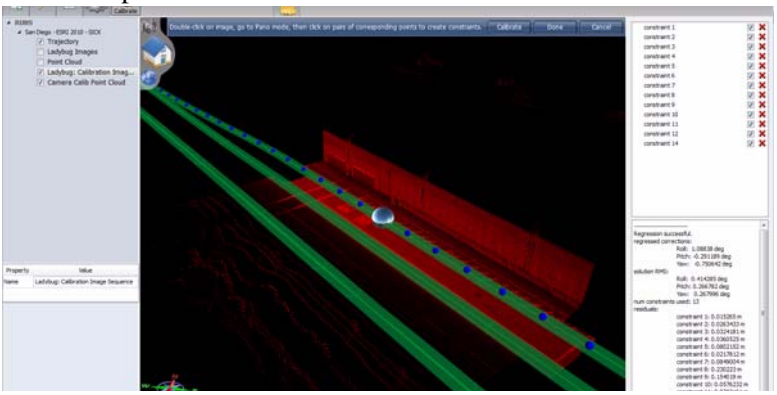


Figure 7-7. Regression Statistics Generated in the Lower Right Panel

6. The **Save As** dialog box appears. Save the calibration text file.

Updating the Dataset with a New Camera Calibration

This section describes how to update the alignment of the camera images and point cloud data for the IP-S2 dataset to see how adequate the new camera calibration is before updating the calibration of the IP-S2 system.

1. If the IP-S2 dataset is open, close it by clicking **Tools ▸ Close**.
2. Close or minimize Spatial Factory.
3. Using Geoclean Workstation, open the project folder that contains the IP-S2 dataset in which the camera was calibrated in Spatial Factory. For information about Geoclean Workstation, see the *Geoclean Workstation User's Manual.*

4. On the **Job Info** tab, select **Pics Poser**, select the check box of the camera type being used, and then click **Start**.

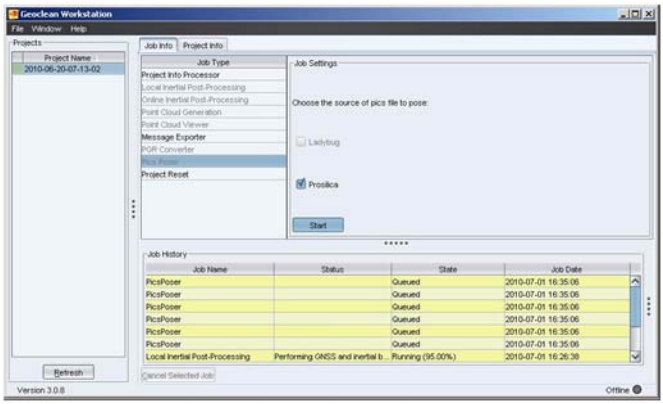


Figure 7-8. Job Info Tab – Pics Poser

5. When the Pics Poser process finishes, close Geoclean, and open Spatial Factory.
6. Click the **Open** icon or click **File ▸ Open**.

The **Browse For Folder** window appears (Figure 7-1).

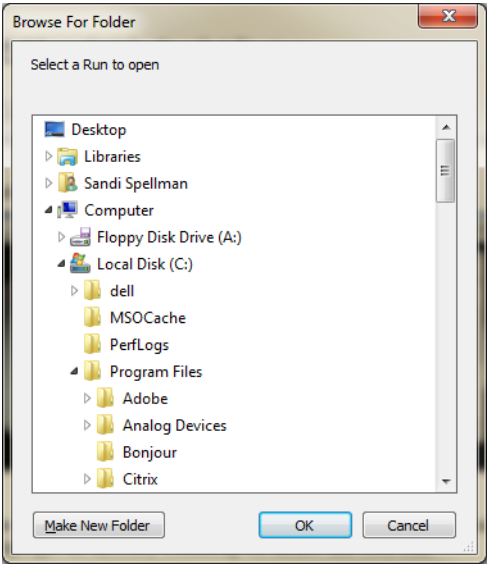


Figure 7-9. Browse For Folder Window

7. Locate the directory that contains the same IP-S2 dataset upon which the camera calibration was performed, select it, and then click **OK** (Figure 7-1).
8. Load a trajectory from within the dataset:
    1. Zoom in (roll the scroll wheel away from you).
    2. Click the **Load** icon or click **File ▸ Load**.
    3. Click on the trajectory to select a start point, follow the highlighted trajectory, and click to select the desired end point.
    4. Once the desired segments is selected, click **Load** on the pop-up toolbar. This loads the collected point cloud data and camera images. The camera images are the blue spheres.
5. Double-click on a loaded image. As shown in Figure 7-10 and Figure 7-11, the point cloud data and camera images are now aligned.

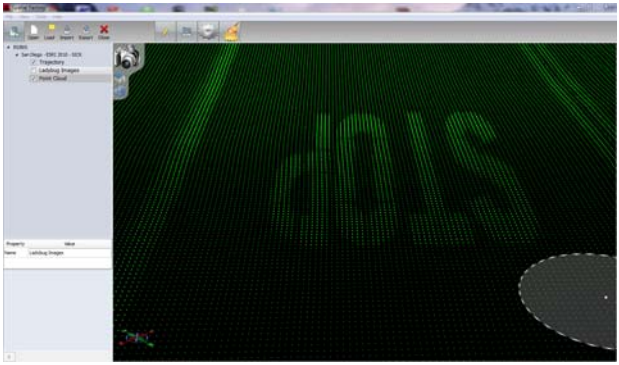


Figure 7-10. Point Cloud Data

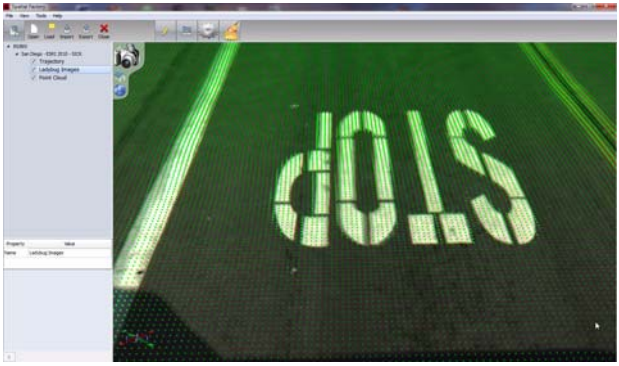


Figure 7-11. Point Cloud Data Overlaid with Images

Updating the IP-S2 System Camera Calibration

To load a new calibration file onto the IP-S2 box, perform the following steps:

1. Make sure the Ethernet cable is connected to the logging computer.
2. Turn on the IP-S2 system by pressing the On button on the IP-S2 box.
3. Open a Web browser, and type **http://ips2** or **http://192.168.2.166** in the browser address bar to open the IP-S2 Web Manager.

Figure 7-12. IP-S2 Web Manager – Configuration Page – Calibration Update

4. On the IP-S2 Web Manager, click **Configuration**.
5. Expand the **Calibration Update** section.
6. Click **Browse**, locate the new camera calibration file generated by Spatial Factory on the computer, and then click **Open**.
7. Click **Upload** in the **Calibration Update** section. The new camera calibration file will be installed onto the IP-S2.
8. Close the IP-S2 Web Manager.

Topcon Positioning Systems, Inc.
7400 National Drive, Livermore, CA 94550
800·443·4567 www.topconpositioning.com

Spatial Factory User's Manual

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